WASHINGTON

QUINAULT COASTAL ZONE MANAGEMENT PLAN

february 1979

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The preparation of this report was financially aided through a grant from the Washington State Department of Ecology with funds obtained from the National Oceanic and Atmospheric Administration and appropriated for Section 306 of the Coastal Zone Act of 1972.

This report was also financed in part through a Comprehensive Planning Grant from the Department of Housing and Urban Development and through an Indian Self-Determination Grant from the Bureau of Indian Affairs.

RESOLUTION NO. 79-106

of the

QUINAULT BUSINESS COMMITTEE

WHEREAS, the Quinault Business Committee is the governing body of the Quinault Indian Nation, and

WHEREAS the coastal zone is one of the most valuable yet fragile resources of the Quinault Indian Nation, and

WHEREAS, it is desirable to manage the many coastal zone uses to provide for the maximum possible overall benefit to the Quinault Indian Nation: Now therefore be it

RESOLVED, that the Quinault Coastal Zone Management Plan, February 1979 is hereby adopted.

Joseph B. De La Cruz

Joseph B. DeLaCruz, Chairman
Quinault Business Committee

CERTIFICATION

As Secretary of the Quinault Business Committee, I hereby certify that the foregoing resolution was duly enacted by the Quinault Business Committee at Taholah, Washington on the 20th day of Feb ,1979, and was adopted by a vote of 5 FOR and 0 AGAINST, at which time a quorum was present and voting.

Pearl L. Baller, Secretary
Quinault Business Committee

QUINAULT BUSINESS COMMITTEE

Joseph DeLaCruz, Chairman
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Pearl Baller, Secretary
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ACKNOWLEDGEMENTS

The Quinault Coastal Zone Management Plan owes its existence to the Quinault Planning Commission. The members of the Commission provided the initiative, the guidance, and the motivating force. Through innumerable lengthy meetings, private discussions and the many valuable suggestions they offered, the direction of the plan was formulated.

The Quinault Forestry and Fisheries Departments provided valuable assistance in supplying maps, aerial photos, detailed data and other information from their respective programs.

Much is owed Alena Masten for the time and dedication she spent in typing and preparing this document in its final form.

Thomas E. Purkey
Land Use Planner

QUINAULT PLANNING COMMISSION

Frank McMinds, Chairman
Alena Masten, Vice Chairman
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Linda Northrup

PREFACE

This document has been prepared with funding from three sources. Most of the preliminary gathering of data and information was carried out under a 701 Comprehensive Planning Grant from the U.S. Department of Housing and Urban Development. The plan developed into its final form under a grant from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. That grant was administered by the Washington Department of Ecology. Required matching funds for both of these grants were provided by the Bureau of Indian Affairs 93-638 Indian Self-Determination program.

Parts I and II of this plan were written to follow the general outline of the State of Washington's Coastal Zone Atlas. Much of the general information, where it is applicable to the Quinault Reservation was taken from the Atlas. It is recognized that the coastal zone has its own natural boundaries which do not necessarily conform to man's artificial political boundaries. Coastal processes and uses are interrelated, more so perhaps than those in any other region. By using the same general outline and as much of the same type of information as is available the coastal zone programs of the Quinault Indian Nation and the State of Washington can more easily be coordinated to the ultimate benefit of both. The outline of the Quinault Coastal Zone Management Plan differs from that of the Atlas to some extent due to the availability or lack of availability of certain data.

An attempt has been made to emphasize information which has not been fully dealt with in other planning documents of the Quinault Indian Nation which taken together constitute its comprehensive plan. Repetition of detailed information presented in the other planning documents has been avoided as much as possible consistent with a clear presentation here.

CONTENTS

PART I - INTRODUCTION

During the late 1960's use of the beaches of the Quinault Reservation for recreational activities by the general public increased rapidly, brought on by the booming economy and growth of the Seattle area which created a great demand for recreational activities on all of Washington's Pacific coastline.

By 1969 use of the Quinault beaches had grown to the point where hundreds of people were using them on summer weekdays and thousands on weekends. The beach just south of Pt. Grenville was noted as one of the few good surfing beaches in Washington and had the heaviest use.

During the summer of 1969 the citizens of the Quinault Nation noted with growing alarm the rampant abuse of their beaches. Real estate developers were scooping up sand to use as fill for nearby homesites and dumping logs and stumps back on the beach. Raw sewage was being dumped by campers. Truckloads of driftwood were being hauled away. Fishing nets left out to dry were stolen. Beach rocks with ancient legendary significance to the Quinaults were defaced with painted graffiti. Littering was indiscriminate and the valuable razor clam beds were being poached and damaged heavily.

Finally a meeting was called and on August 25, 1969, by a unanimous vote of the full tribal council, the Quinault Nation closed its beaches to all non-tribal members. James Jackson, Tribal Chairman, made the announcement with these words: "We live by an ocean with clean beaches, a river with clean water, and clean air all about us. That's the way it is going to be!"

The closure generated a great deal of publicity and almost universally favorable reaction, except from real estate developers. Over a thousand letters from around the country were received in support of the Tribe's action.

To reinforce its objective of preserving the natural quality of the reservation coastline the Tribal Council passed a Zoning Ordinance which designated the coastline strip as a wilderness zone. Only carefully controlled uses and developments which would not permanently detract from the natural environment were permitted.

In 1976 the Land Use Planning Office was organized in the Tribal Government with one of its main responsibilities to develop ordinances and programs to protect the resources and preserve the natural beauty of the coast. In December 1976 a revised and more detailed Tribal Zoning Ordinance was enacted to provide better legal protection.

In the mid 1970's after passage of Washington state's Shoreline Management Act of 1971 and the federal Coastal Zone Management Act of 1972 the Quinault tribe began efforts to obtain funding for a better coastal zone management program of its own. The previous actions had served to protect the coast from the most obvious abuses but did not provide for any positive management of coastal resources.

The United States Congress' passage of the Coastal Zone Management Act of 1972 provided a clear expression of the nation's interest in promoting wise management of its coastal resources. The Act provided incentives and funding for the states to develop coastal zone management programs, but did not include provisions for Indian reservations. Since reservations do not come under state jurisdictions they were in effect excluded from the program and left as blank spots on coastal zone management maps.

In FY 1977 the Quinault Tribe was able to include coastal zone planning funding in a HUD 701 grant. Information compiled under this program provides much of the data for this document.

Finally, in 1977 the Coastal Zone Management Act was clarified to specifically include coastal Indian Reservations. Coastal zone management funding was approved for the Quinault Indian Nation in FY 1978 by the Office of Coastal Zone Management of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce through Washington State's Department of Ecology. It is under this program that the Quinault Coastal Zone Management Plan was put together in final form.

OVERVIEW OF COASTAL RESOURCES

The Quinault Reservation's coastline consists of 24 miles of Pacific Ocean frontage and contains the richest commercial razor clam beds in the world. The coastal area contains two of the three towns on the Quinault Reservation and 90% of the total population (almost 100% of the Indian population). The estuaries of 2 major rivers, 2 minor rivers and 4 large creeks also lie within the coastal zone. These are areas vital to the harvest and propagation of salmon and steelhead which contribute a significant part of the reservation's economy and have a central role in Quinault culture.

One of the greatest resources of the coastal zone is difficult to quantify. It is the magnificent unspoiled natural beauty of the broad sandy beaches, unique rock formations and towering seacliffs that make up the shore and provide a continual renewal of spirit to the Quinault soul.

BASIC RESOURCES

The Quinault coastal zone may be divided into two major physiographic areas. North of Pt. Grenville the coast is characterized by rocky narrow beaches of generally coarse sand and gravel, backed by high bluffs topped with flat terraces. Several rocky outcrops and islands lie offshore forming the Copalis Rocks National Wildlife Refuge and providing undisturbed nesting sites for birds and habitat for marine mammals such as sea lions, seals and otters. The Quinault, Raft and Queets river valleys provide the only breaks in the high coastal bluffs of this region. The river estuaries and flood plains are rather limited in extent. Development is concentrated within the towns of Taholah and Queets. The remainder of the region is unaltered except for several, mostly rustic, weekend cabins scattered along the coast and a great deal of logging activity. Access to the coast between Taholah and Queets is severely limited. The Cape Elizabeth road parallels the coast, but is a rough narrow gravel road which is infrequently maintained. The high bluffs prevent any beach access except at a few unmarked spots.

The region south of Pt. Grenville is characterized by wide sandy beaches backed by bluffs set some distance back from the vegetation line. Beach sand is provided by the northward littoral drift of sediments being stopped and backed up by Pt. Grenville. These beaches provide the most popular recreational areas of the coast as well as almost all the commercial razor clam beds on the reservation. This area has been attractive for real estate development and several permanent homes presently exist which were built prior to the beach closure and the area being zoned wilderness. Most of the coastline, however, remains unaltered. Access to this area is via Washington Highway 109 which parallels the coast between Moclips and Taholah and provides easy access to beach in a number of spots.

The bluffs, particularly north of Pt. Grenville, are susceptible to fluvial and marine erosion and can present serious slide hazards. They are topped with unconsolidated gravel of glacial stream origin and underlain by rather weak sandstone, graywacke and shale bedrock. Storm waves and high tides continually undercut the bluffs causing them to frequently slide. Some parts of the coast bluffs are estimated to be receeding an average of three feet per year. This continuous slide action makes much of the coastal area hazardous for future development.

Flooding in the coastal zone has historically not been too serious of a problem. There is potential for flooding, however, in the old river floodplains on which Taholah and Queets are built and in the lowlying areas adjacent to the beaches south of Pt. Grenville.

Coastal ocean currents are mostly to the north during the winter and to the south during the summer. Due to frequent storms during the winter it is the northward current which carries the greatest sediment load. During the summer a general upwelling of water from lower depths occurs. The upwelled water is cold, high in salinity, low in oxygen and rich in nutrients. It triggers a bloom of marine plant life essential to razor clams and many other marine creatures. Chinook and coho salmon are attracted to the feed brought to the area and make it an important commercial and sport trolling ground. Humpback whales also pass through the area, often quite close to shore, on their annual migrations.

FISHERIES AND WILDLIFE RESOURCES

The commercially valuable species of the coastal zone of the Quinault Reservation are the razor clam, dungeness crab, steelhead trout, and four species of salmon: chinook, coho, sockeye (blueback), and chum. Except for the dungeness crab which is harvested almost exclusively by non-Indian fishermen, these species provide an extremely important part of the Quinault economy. Quinault fishermen annually harvest over 50,000 salmon and steelhead from the Quinault and Queets Rivers. In addition clam diggers harvest over 250,000 pounds of razor clams annually. The total annual processed value of the fish and clams from the reservation is about $1,000,000.

Historically the river systems of the reservation have supported much larger numbers of salmon than at present. Estimates range up to about five times the present number. Most of this resource loss is blamed on environmental degredation from poor logging practices on the Reservation and from the extensive ocean fishery. The Quinault Fisheries department is working actively to replenish fish stocks through extensive hatchery and fish propogation programs as well as intensive management of existing stock.

The razor clam resource is potentially vulnerable to coastal land uses. Increased development adjacent to the clam beds would increase problems of poaching and physical damage. In addition the nature of the soils makes septic tanks only marginally effective, at best, creating a potential for contamination of the clams.

Besides the commercially valuable species a great number of other animals inhabit the coastal zone. Mammals include black bear, black-tailed deer, an occassional Roosevelt elk, marten, fisher, river otter, mink, longtail weasel, striped skunk, spotted skunk, coyote, raccoon, beaver, rabbit, porcupine, mountain beaver, mountain lion, lynx, sea lion, seal, humpback whale and perhaps sea otter.

The coast is the Pacific flyway for thousands of migratory birds, many of which nest on the offshore rocks and islands. Bald eagles, red-tailed hawks, and perhaps peregrine falcons nest within the coastal zone also, although several nesting sites for these birds have been destroyed or disturbed by logging.

FORESTRY RESOURCES

Generally the forest areas of the Quinault Reservation can be thought of as the inland boundary of the coastal zone. The forest begins usually at the top edge of the sea cliffs bordering the coast. Use of the forests near the coastal zone can have a great impact on the resources and characteristics of the coastal zone proper; affecting its suitability for recreation and development, determining abundance and makeup of wildlife species, affecting the rate of erosion of the sea cliffs and bluffs, and determining the quality of the estuarine environments.

The forests of the coastal zone are extremely valuable commercially, although generally of somewhat poorer commercial quality than the forests farther inland. The commercial species include Western redcedar, Sitka spruce, western hemlock and Douglas fir. Logging is generally done in large clearcuts, sometimes because of disease control or windthrow problems, but more often because it provides the greatest short term profit. Selective logging and logging in limited-sized clearcuts have not been included in logging practices in the coastal area so far.

Slash residues are particularly heavy after logging in the coastal areas. This, along with generally poor soils and a stressed forest environment near the coast make forest regrowth somewhat slower than elsewhere on the Reservation.

POPULATION

The total population of the coastal zone is now estimated to be 1330 persons: with 1000 residing at Taholah, 300 at Queets and 30 in individual houses along the coast. Developed land in Taholah occupies 130 acres and in Queets 26 acres.

Most of the population growth that has occurred in recent years has been in Taholah. The growth has been quite rapid in the past 10 years as the quality of life and economic opportunities on the Reservation have improved. Population is expected to continue increasing at a rapid pace due to a continuing high birth rate among Quinaults and an influx of Quinaults who have been living elsewhere returning to the Reservation. Population growth is now averaging between ten and fifteen percent annually.

RESOURCE OWNERSHIP AND USE

The entire beach area of the Reservation up the extreme high water line is owned by the Quinault Tribe. Of the coastline landward of the extreme high water line, 17 percent (4 miles) is owned by the Quinault Tribe, 37 percent (9 miles) by indivdual Indians under trust status with the federal government, and 46 percent (11 miles)by individuals, mostly non-Indians, in fee patent ownership.

This situation leads to an inherent conflict between the goals and objectives of the Quinault Tribe, as owner and manager of the beaches and tidelands, and the often much different aspirations and desires of the private upland owners, particularly those who are non-Indian. The conflict is expressed politically through opposing claims of jurisdictional authority over individual pieces of property by tribal government, county government and federal government. At this time the legal authority of the various jurisdictions is unsettled and confusing, particularly to the property owners involved. Until definitive judicial decisions are handed down to decide the issues proper management of the coastal zone will be extremely difficult. Effective coastal zone management will depend largely on being able to reach a consensus among the governments involved on specific issues. Where a consensus cannot be obtained the government able to exert is political will most strongly will probably prevail, at least for the short term.

Until the jurisdictional issues are settled legally or a greater consensus among the governments involved can be reached the use potential of the incredibly rich coastal resources cannot be maximized fully. The primary competing uses to be balanced include timber harvest, commercial fishing, recreation, razor clam harvest, residential development, second home development, tourism, and wilderness preservation. Overriding all of this is the steadfast determination of the Quinault Indian Nation to forever maintain the Quinault culture and society as its own unique and living part of American life.

PART II - COASTAL ZONE DATA

Coastal zone management is actually carried out through the political decisions of the various governments as well as the individual actions of landowners. Generally it is the landowners who initiate management decisions for individual gain or benefit. The role of government is then to direct and channel the individual actions in such a way that individual gains also benefit the society as a whole rather than being at its expense. In view of the great importance of governmental consensus for coastal zone management on the Quinault Reservation at the present time, establishing a reliable data base is most necessary.

Often when there is a good base of data concerning a particular situation certain solutions become obvious and governmental consensus is easy. A good example might be a property owner desiring to build a house near the edge of a bluff to get a good view of the ocean. If data was available which indicated the bluff was unstable the obvious and proper action of any government would be to establish rules requiring at least a safe setback for the house.

The availablility of a detailed, accurate and uniform set of data for certain types of environmental information is a common need of all groups affecting coastal zone management decisions. This part of the Coastal Zone Management plan is designed to upgrade that data base.

INDIVIDUAL COMPONENTS

The information contained in this part is displayed in seven data categories considered essential for effective coastal zone management and land use decisions.

A. COASTAL GEOLOGY SURVEY - The term "coastal geology" refers to the stratigraphy and lithology of rock materials and their structural relationships, resource potential and engineering properties. Geology plays a major role in the formation of soils types and in the interpretation and understanding of geologic hazards. Its most direct role of course is to show the extent of rock and mineral resources or lack of them within the coastal area.

B. COASTAL DRIFT SURVEY - Coastal drift refers to the erosion, transport, and accretion of shoreline sediments and their associated landforms. An understanding of coastal drift provides decision makers with a knowledge of the possible consequences of interfering with any part of dynamic shoreline processes.

C. SOIL SUITABILITY FOR DEVELOPMENT SURVEY - Soils provide the working surface upon which most land uses occur. There are two primary soil factors which determine the suitability of a soil for groundbreaking types of development: (1) strength of the soil to adequately support foundations and structures; and (2) water percolation rate and drainage capacity of the soil to carry water away from structures and adequately handle septic tank effluent.

D. NATURAL HAZARD SURVEY - Natural hazards include both salt water and fresh water flooding potential and land slide potential of the coastal bluffs. This is information which is directly applicable to coastal zone management decisions.

E. CRITICAL BIOLOGICAL AND SCENIC AREA SURVEY - Critical biological areas are specific geographical habitats which are essential for the survival of certain species on the Reservation. They are particularly sensitive to human activities and land uses.

Scenic areas are those portions of the coastline which have unique scenic value which could be diminished by uncontrolled land use. Ironically, their very attractiveness is what makes them most susceptible to potentially damaging land use decisions by individual property owners acting in their best self interest.

F. LAND COVER AND USE - Upland land cover classifications are associations of plants which occur together due to soil types, moisture content, slope and human activities. Associated with these covers are various types of species habitat. Some species occur in only one or two types of cover while others may range over a number of units. These maps also show past and present human land use activities.

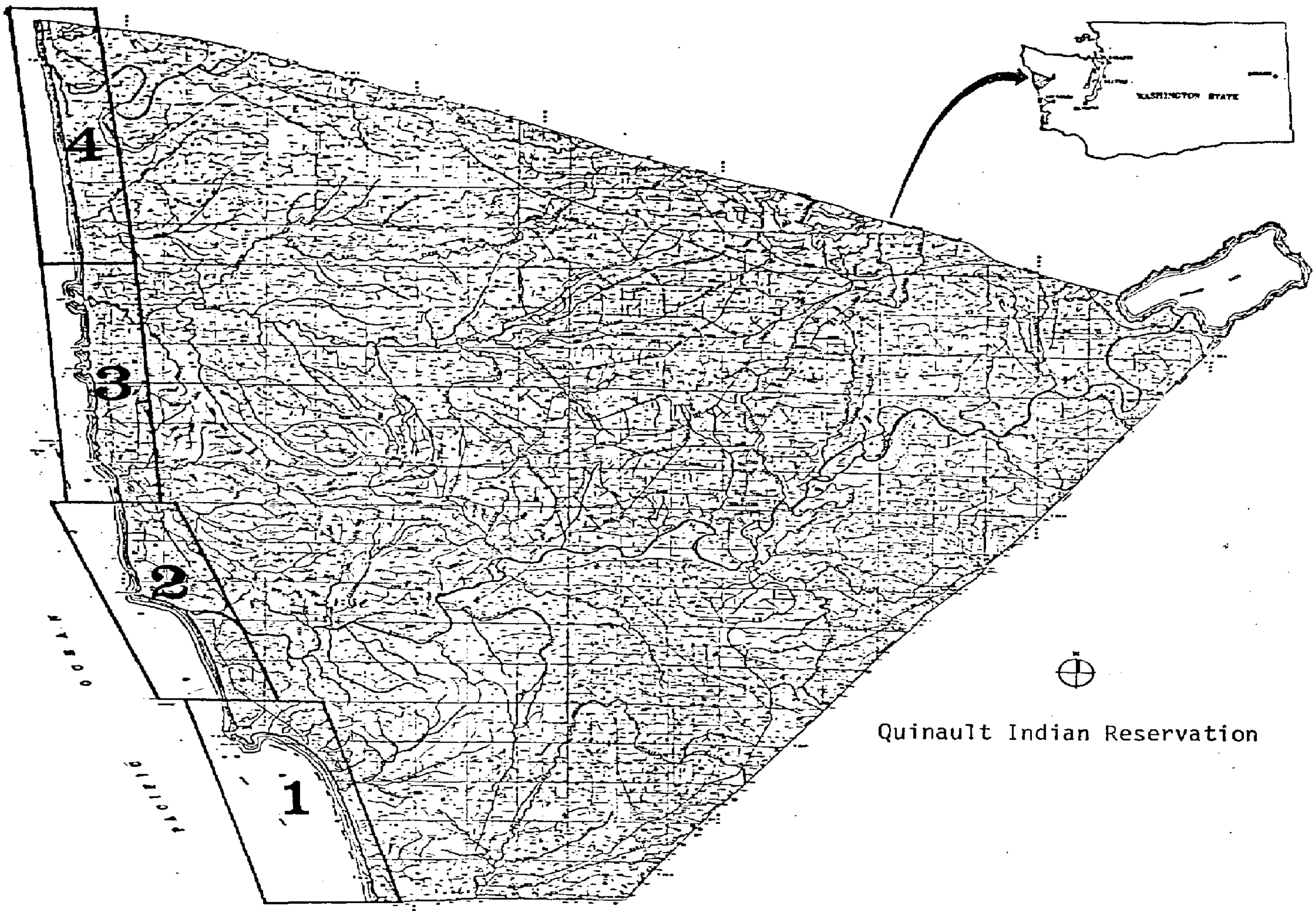
G. LAND OWNERSHIP AND COASTAL ACCESS - The present pattern of land ownership and access will have a great effect on future uses of the coastal area and on the political decisions which guide them. This information provides a base for evaluating the extent of change in land use as it occurs in the future.

LIMITATIONS

Utilization of the information contained in the maps is limited by two constraints: map scale and accuracy of the data collection. The maps are drawn so that one inch on the map equals one half mile on the ground. At this scale the width of a map boundary line would cover approximately fifty feet on the ground.

This data was derived from a review of available literature, spot verification in the field, original field surveys and interpretation of aerial photography. Not every foot of ground was field checked. Given the available time and funds it was necessary to group a great deal of complicated, heterogeneous data into a few simplified categories. Actual boundaries between categories may be gradational and thus, may depend on interpretation of detail and be located only approximately within a few hundred feet.

These limitations do not diminish the utility of the data for regional and policy decision making or for first look assessments of specific project sites. Final decisions, however, on specific project sites will usually involve more detailed on-site inspections.



AREAS OF INDIVIDUAL MAPS 1 - 4

A. COASTAL GEOLOGY

GEOLOGIC MAPS

A geologic map shows the distribution of different earth materials within a particular area. As these materials are often covered by obscuring soil or vegetation, the process of geologic mapping resembles detective work. The field geologist must reconstruct a three dimensional puzzle with most of the pieces missing. To do this, the geologist must examine as many natural or manmade exposures of the earth materials as possible. After studying beach bluffs, stream banks, road cuts and other exposures, all indirect information such as similar units in other areas is also used. These data are supplemented by a careful study of aerial photographs. The photographs give a broad view of the landforms present and this knowledge allows the geologist to come to additional conclusions as to the nature and distributions of the different earth materials.

An integral part of any geologic map is the explanation or legend, which describes the rock units mapped and shows their age relationships. A knowledge of the age of a unit is a useful tool in the preparation of a geologic map. As the sequence of units is rarely complete at any given place, absolute ages obtained from radiometric dating or fossil identification, or relative ages obtained through interpretation of the relationships among geologic units are useful in projecting known correlations into poorly understood or unknown areas.

A geologic map leaves much room for interpretation and personal judgement. For example, where a formation lenses out laterally it may thin from tens of feet in thickness to inches over a distance of a mile or more. The decision of where a unit's thickness has become insignificant and therefore unmappable will vary from one geologist to another.

On the other hand, mapping of a vertical contact between two markedly different formations exposed in a beach bluff may be done with great accuracy and complete agreement between two mappers. Also, as the degree of exposure between geologic materials may change from place to place, the "confidence level" in mapping will also vary from one area to another.

LAND USE APPLICATIONS

Individuals who make land use decisions, whether they be property owners, developers, engineers, or administrators, can improve their judgement if provided with more and better information. Geologic maps provide useful data on the characteristics of the underlying rocks and "engineering" soils. For example, physical properties and relationships between geologic units dictate the nature of occurrence and movement of groundwater. This groundwater controlling aspect of the geologic units is crucial to many land use questions, not only from the water supply point of view, but from the water as a nuisance point of view. Questions regarding travel of garbage dump leachates or the existence of groundwater perching layers that may cause landslides can only be answered after a study of the subsurface materials.

A geologic map can also provide information on the presence or absence of other resources such as gravel or quarry rock. Foundation characteristics during normal conditions and under earthquake shock stress can be inferred from a knowledge of materials beneath the surface. Geologic units play a dominant role in the stability of slopes Some ideas as to the relative erodability and bank failure due to wave cutting can be obtained from information on bank materials. Estimates as to ease or difficulty of excavation and thus the type of equipment necessary can also be made.

While the foregoing information may often be inferred directly from a geologic map, it may be more convenient to prepare a separate map displaying a particular physical property of the land. Such "interpretive maps" usually show relative properties. Examples are the slope stability units shown on the Natural Hazards map in this plan. Obviously, these maps should be used as a generalized guide only and not for detailed analyses of all specific sites within the map area.

QUINAULT INDIAN RESERVATION GEOLOGY

There are four general geologic units which have been mapped along the coastline of the Quinault Reservation: (1) Volcanics, (2) the Hoh Melange, (3) the Quinault Formation, and (4) overlying sand and gravel deposits.

VOLCANICS

The volcanic rocks are the oldest rocks exposed along the coast and also the most resistant to erosional forces. These rocks form most of Pt. Grenville and the nearby on and offshore rocks and seastacks. Microfossils contained within interbeds of marine siltstone indicate that these rocks were formed 45 to 50 million years ago during middle Eocene time. They were formed as submarine lava flows which mixed with seafloor sediments and mud as they were ejected. The rapid cooling of the lava by seawater caused it to solidify in the form of volcanic glass and very fine grained basalt. Much cracking and fracturing of the rock also occurred because of the rapid cooling. Over the millions of years since its formation much of the rock has lost its glassiness and the fine fragments have become welded together into a volcanic breccia. Many of the cracks and fractures are now filled with veins of secondary calcite or zeolite minerals. The ocean mud and sediments have solidified into contorted layers of siltstone. Nearly continuous crustal movement since these rocks were formed has caused them to become contorted and steeply tilted.

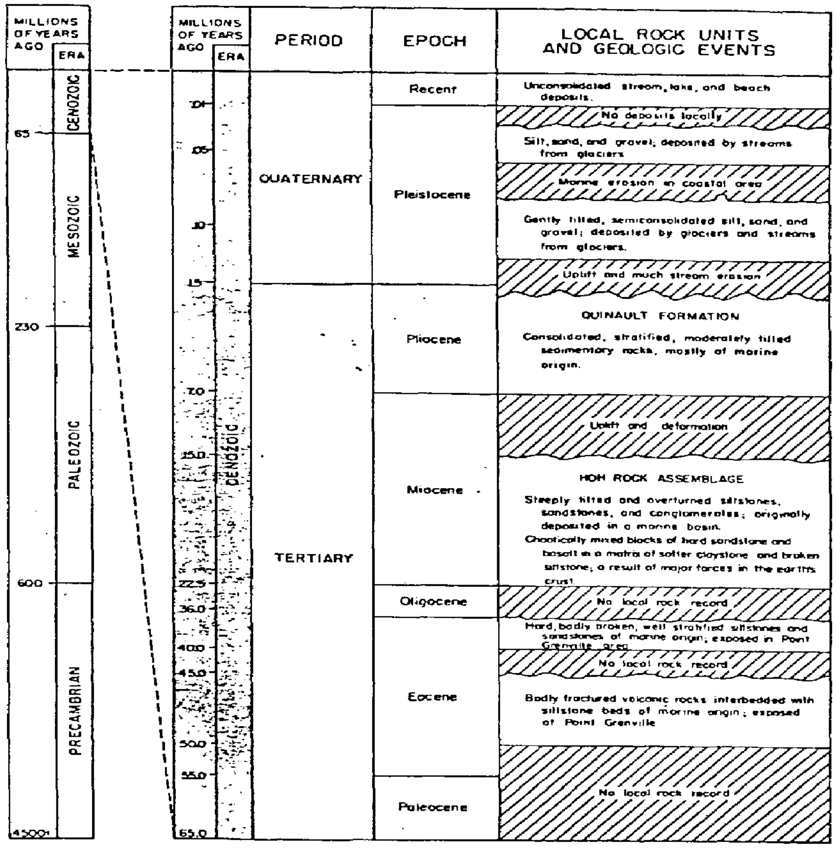
HOH MELANGE

The Hoh Melange is younger than the volcanics. Microfossils show these rocks to have been formed 15 to 22 million years ago during middle Miocene time. The Hoh rocks comprise what is called a "tectonic melange". They are a chaotic mixture of relatively hard and resistant rocks set in a fine grained matrix of softer rock much like peanuts in chunky peanut butter. The hard chunks of rock are in all different sizes and consist of conglomerates, sandstone, siltstones and altered volcanics. The relatively soft fine-grained materials of the matrix are mostly clays and broken siltstone. The melange rocks are mostly dark gray in color and often exhibit a petroleum smell when freshly broken.

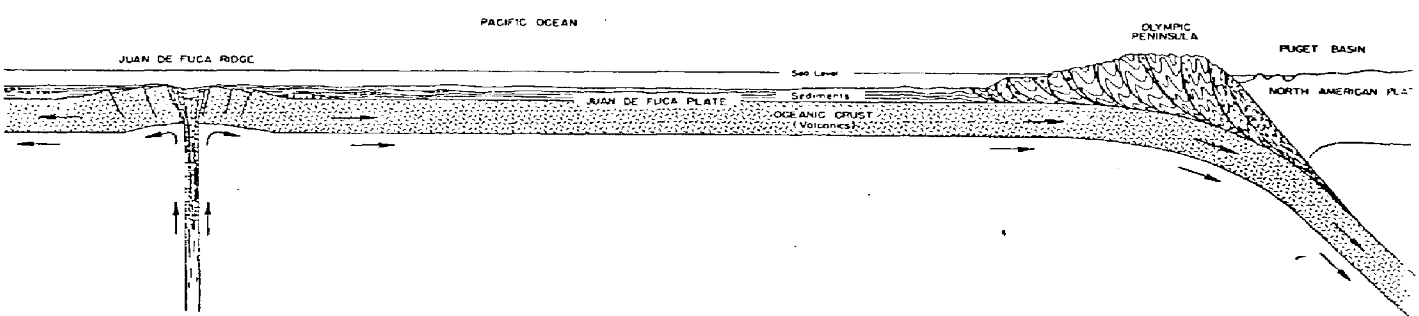
The Hoh Melange is structurally very weak and is highly susceptible to erosion. In most places where it is exposed it has slumped and eroded extensively. The slumping is caused by the expanding nature of the clay minerals when they become wet together with periodic wetting by ocean waves and precipitation. Some sections of the coastline where the Hoh Melange is exposed are eroding back an average of 3 feet per year.

Some of the resistant chunks of rock, particularly the volcanics, within the Hoh Melange are extremely large. As the softer matrix is eroded away by wave action these resistant blocks are left behind. Big and Little Hogsback, Willoughby Rock, Split Rock and the large boulders in the Hogsback vicinity were formed in this way.

The jumbled and chaotic formation of the Hoh Melange is thought to reflect the massive tectonic forces which have created the Olympic Mountains and which is explained by the concepts of plate tectonics and seafloor spreading. Sediment age data from the seabed off the Olympic coast indicates that the oceanic crustal plate is expanding eastward from the Juan de Fuca Ridge some 250 miles offshore at a rate of slightly over one inch per year. Where the oceanic plate meets the North American continental plate it is thrust downward.



GEOLOGIC TIME CHART.



A DIAGRAMMATIC SECTION showing how the structurally complex rocks of the Olympic Mountains and of the west coastal area may have been formed. Sediments, now lithified to rock such as the Hoh rocks, have been carried eastward, relative to the continent, on a thick oceanic crust of volcanic rock a few inches a year for millions of years. Where the heavier rocks of the Juan De Fuca plate met the lighter rocks of the North American plate, most of the rocks of the former moved beneath those of the continent and were dragged into the depths of the earth and were converted to magma. However, it is believed some of the materials were not thrust under the continent but were "skimmed off," foreshortened by crumpling and successive underthrusting, piled up, and accreted to the western edge of the North American plate. The present-day Olympic Mountains and complexly folded and faulted Hoh rocks along the coast are believed to represent the rocks of this "pile."

(Diagrams by Weldon W. Rau, Washington Department of Natural Resources, Geology and Earth Resources Division, Bulletin No. 66, 1973.)

Over the millions of years of movement the upper layers of accumulated sedimentary rocks have been skimmed off. These rocks have become highly folded and faulted as they have been skimmed and piled up to form the Olympic Peninsula and Olympic Mountains. Since the Hoh rocks are very weak structurally they have undergone particularly extreme deformation and breaking as the plates have moved.

QUINAULT FORMATION

The Quinault Formation is considerably younger than the Hoh Melange. Fossil dating shows it to have been formed 1½ to 7 million years ago during the Pliocene age. The rocks of this formation are generally massive light brown or buff colored sandstone, siltstone and conglomerate. Fossils of clams, snails, foraminifera and trees are abundant at places within the formation. Although these rocks are not particularly hard or resistant they are much stronger structuraly than the Hoh Melange rocks. They form most of the high cliffs which characterize much of the Quinault Reservation coastline, including Cape Elizabeth, Pratt Cliff and Tunnel Island. The strata of the Quinault Formation are only slightly deformed having gentle tilting and occasional faults. They are far less disturbed than the rocks of the Hoh Melange. The entire thickness of the Quinault Formation strata if placed in their original horizontal position would be about six thousand feet.

The Quinault Formation is of particular interest because it is regarded as a favorable potential petroleum reservoir trapping oil and gas released from the underlying Hoh rocks. Although the Quinault Formation is not known to outcrop more than 3 miles inland it has been mapped at least 20 miles offshore and for a distance of 40 miles along the coast. A series of natural gas seeps occur near the Garfield Gas Mound which are probably caused by natural gas rising along a fault in the rocks. Although there is presently no oil or gas production from the Quinault Formation there is a future potential, particularly in the offshore areas.

Though not as susceptible to erosion as the Hoh Melange the Quinault Formation is still easily eroded by the action of the surf. The cliffs are constantly being undermined and slumping or breaking off due to wave action. A number of natural arches have been formed by the waves eroding the sandstone strata at Cape Elizabeth and Tunnel Island. Tunnel Island is particularly noted for a hollowed out "ampitheater" extending under and completely through the island and for the unique and scenic set of arches known as "Elephant Rock".

SAND AND GRAVEL DEPOSITS

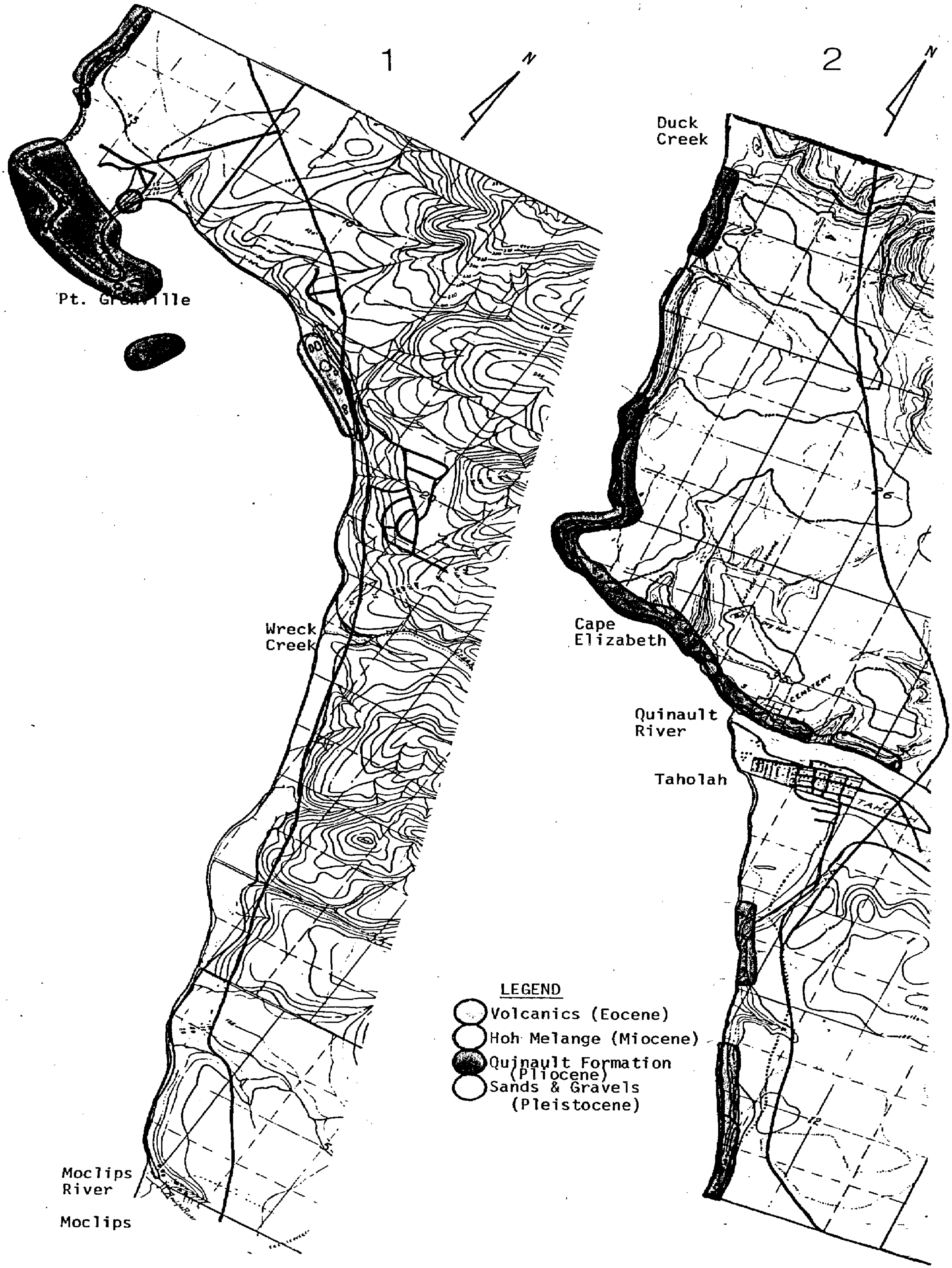
The semiconsolidated sand and gravel deposits which overly all of the previously discussed rocks to varying depths as well as form the seacliffs in the northern part of the coastline are from 17,000 to 70,000 years old. These deposits are composed of rock debris which was carried down out of the Olympic Mountains during at least 4 Pleistocene ice ages and deposited where it is today by streams flowing from the melting glaciers. During an early period of glaciation the sand and gravel formed a broad level piedmont surface with the coast several miles west of where it exists today. Constant erosion and rising sea level have gradually carved the coastline back to its present location. This oldest piedmont surface lies at what is now an elevation of about 400 feet forming the tops of the hills immediately east of the coastal terrace. The coastal terrace between the hills and the tops of the seacliffs is another newer piedmont surface formed during the later periods of glaciation. It lies at an elevation of about 200 feet.

The materials contained in the sand and gravel deposits are derived from bedrock outcrops in the Olympic Mountains. The gravel consists mostly of well-rounded and often fairly well sorted stones of graywacke sandstone often containing black siltstone chips in abundance. These graywacke rocks make up about 85 percent of the gravel. Most of the remaining 15 percent is made up of volcanic rocks. There are also some red argillites, phyllites and cherts from the Olympic Mountains. The gravels contain some clay binder and iron oxide cements so they are able to form steep high bluffs.

The sand layers in these deposits are usually near the top of the beds and were derived from windblown material some 17,000 years ago. The sand is contained mostly in lenses up to several feet in thickness and varying widely in lateral extent. The sand deposits are medium gray in color and generally quite clean of clay or other material.

These sand and gravel deposits form the 100 foot coastal bluffs north of Whale Creek and top most of the sea cliffs along the whole coast south of there. Since they are only semi-consolidated with clay and iron oxide binding they can be quite susceptible to erosion both fluvial and marine, though perhaps not as much so as the Hoh Melange rocks.

COASTAL GEOLOGY



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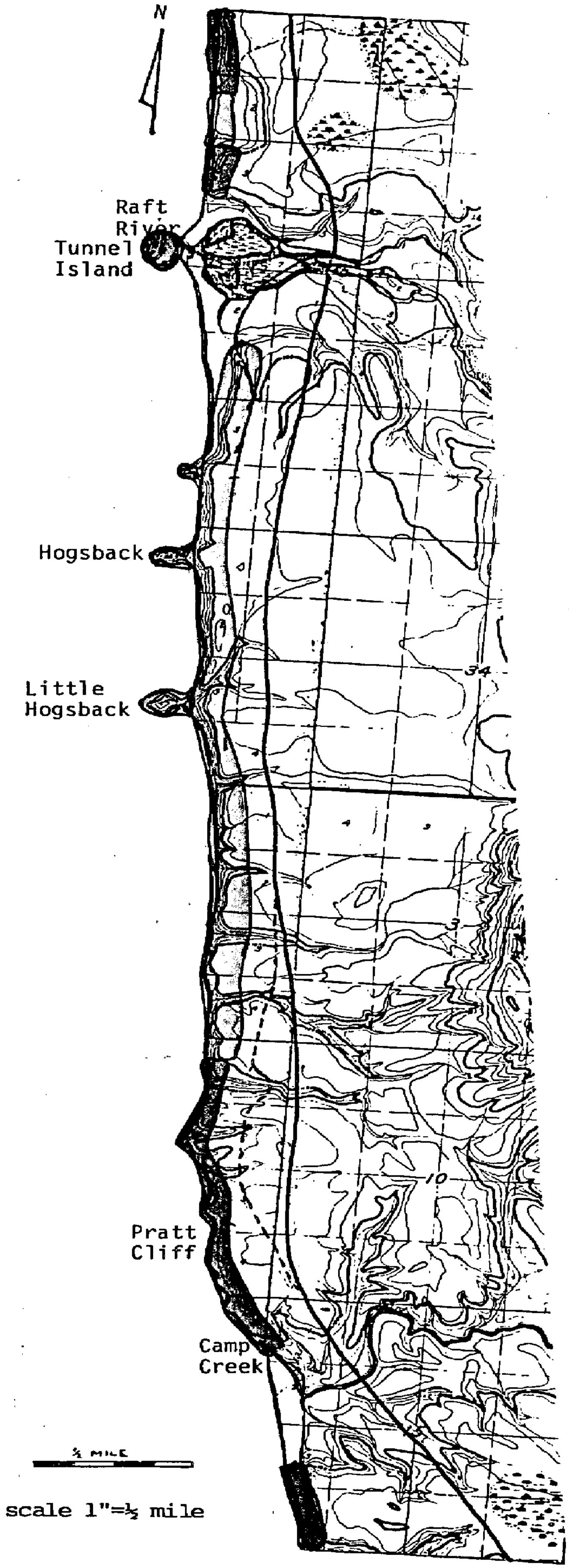
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½ MILE
scale 1"=½ mile

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Queets
River
Queets
CEMETERY
Whale
Creek

B. COASTAL DRIFT

A "drift sector" is a segment of the shoreline along which littoral, alongshore movements of sediments occur at noticeable rate. It allows for uninterrupted movement or drift of beach materials. Each drift sector includes:

(1) A feed source that supplies the sediment.

(2) A driftway along which the sediment moves.

(3) An accretion terminal where the drift material is deposited.

(4) Boundaries which seperate individual sectors from each other.

The basic mechanisms of drift sectors are relatively simple. Waves continually attacking the shoreline with hydraulic and pneumatic action cause turbulence which leads to erosion. Erosion rates depend largely on kind and composition of material in the feed source. Quinault Reservation shorelines generally undergo high rates of erosion due to the nature of the earth materials. Some bluff areas are eroding an average of 3 feet per year. Streams and rivers also supply beach materials, but to a lesser extent. Once drift material is removed from its deposition locale, it can then be swept, either continuously or in seasonal cycles, by wind waves or wind and tide generated currents, along the shores in a more or less parallel motion. Eventually it may be redeposited; ie. accreted on the beach at some distance downdrift, or accumulated offshore in deeper water.

Virtually all shorelines, in particular high bluffs of weak rocks, are subject to continuing erosion. Usually this process is not considered significant until human encroachment onto the shorelines or occupation of the adjacent uplands has occurred. To retain land, people often build protective structures. Such structures, however, may remove the major source of littoral materials. Also, dams built across streams can remove littoral materials from the natural system, but to a lesser extent. The natural system will then adjust to the reduction in available littoral materials by steepening and/or lowering the beach profile and by increasing erosion pressures on unprotected land until a new state of equilibrium is reached. Manmade structures, such as groins and breakwaters, also interrupt the movement of beach materials, resulting in their accumulation on the updrift side of the structures. These structures or mining of beach materials just above low water removes littoral materials from the shore corridor, resulting in significant erosion of adjacent uplands and downdrift shorelines.

The coastal zone as a whole is a dynamic environment, in that the land-water boundary and contiguous land forms are continuously modified and realigned by the forces of the sea. Therefore it is important to identify, recognize, and understand the shore corridor mechanics of drift sectors which play an important role in beach formation or erosion.

The information presented in the coastal drift sector maps is based only on interpretation of existing beach landforms using aerial photos and field observation. Data on speed and volume of sediment transport, seasonally changing conditions, studies of currents and wave data and many other variables are needed on a long term basis before the shoreline processes can be completely understood. The present maps are useful in establishing a better understanding by shoreline managers of the processes involved and the possible consequences of trying to alter any of them. They point out the areas of the Reservation coastline which are the most sensitive to interruption of the littoral drift chain.

Each coastal drift sector shown on the maps operates as an individual chain of three events:

(1) Material is eroded from the bluff or backshore area (the FEED SOURCE) and then ground down to a transportable size.

(2) The material is then moved parallel to the shore (the DRIFTWAY) by currents and wave action.

(3) The material is deposited at the other end, (the ACCRETION TERMINAL) of the particular drift sector.

FEED SOURCE

The shores and littoral drift sectors of the Quinault Reservation receive sediment from three sources: beaches and offshore areas; the strip of land adjacent to the beaches; and upland areas. Obviously, the greater the erodibility of the feeder source, the more sediment it will contribute to drift. The weak rocks of most of the Reservations coastal bluffs are an excellent source of detritus.

Once a feed source is established, a process must exist to break down the material into a transportable form. The most important processes are: scouring, grinding, and reworking of deposits that form beach and nearshore substrates; and physical and chemical weathering of the deposits and rock formations forming slopes and bluffs behind the beaches.

Upland detritus provides an important feed source when transport processes are available to carry it to the coast. These transport processes may include gravity, surface runoff, and streams and rivers that move sediment in suspension and as bed load.

The beaches south of Pt. Grenville depend at least in part on sediments derived from the Cascade Mountains and carried to the coast by the Columbia River. The sediments are then carried north by littoral currents to form the wide sandy beaches prevalent between the Columbia River and Pt. Grenville. Pt. Grenville beach is in effect the northern accretion terminal of a long coastal drift sector beginning at the Columbia River.

DRIFTWAY

Once at the shore and within the reach of waves, the detritus from the feed sources moves in the littoral zone or driftway which extends seaward from the high water line to just beyond the breaker zone. The width of the littoral zone varies according to tidal level and wave height. The outer limit of the zone occurs where the water depth is approximately 1.3 times the wave height.

Littoral materials are put in suspension by wave action and moved along the shore by wave-induced currents, and to a lesser extent by tide-induced currents. During this process, littoral materials move a short distance along the shore and settle out. Subsequent waves will resuspend these materials and continue the littoral process. The direction of littoral drift movement is always in the direction of the prevailing wind and may reverse according to changes in wind direction.

The most significant influence on movement of littoral materials is wave action. Waves are generated by wind moving across the water. The distance that wind blows over open water is called "fetch" and is expressed in miles. The length of time that wind blows across water is called "duration", expressed in hours. Generally the greater the wind velocity, fetch, and/or duration the larger the resulting wave height.

ACCRETION TERMINALS

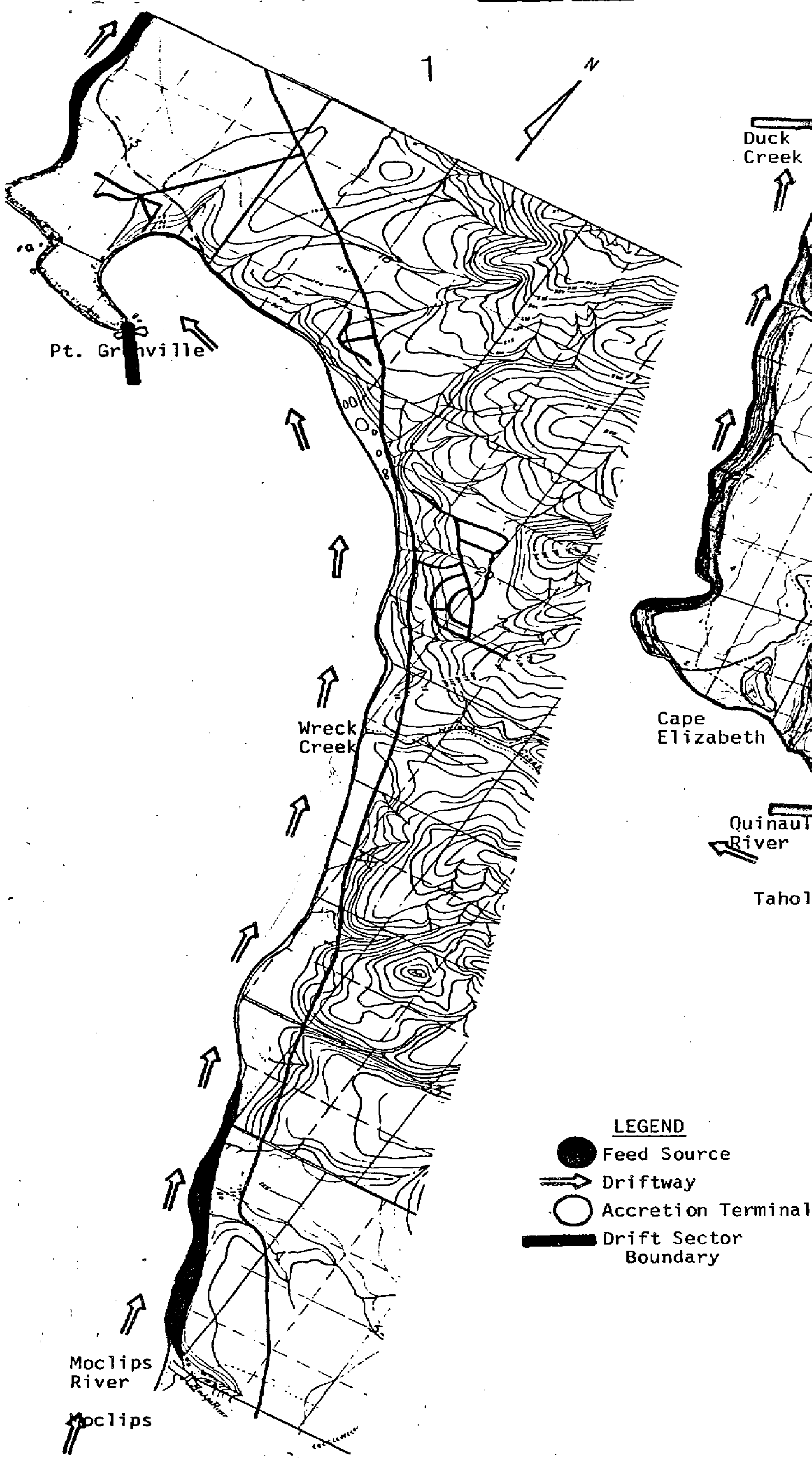
Littoral materials are deposited when wave action and wave and tide induced currents become too weak to move the materials. Generally, the materials will form beaches with alignments that are dependent on prevailing seasonal winds. Material is stored at accretion terminals at the downdrift end of the sector.

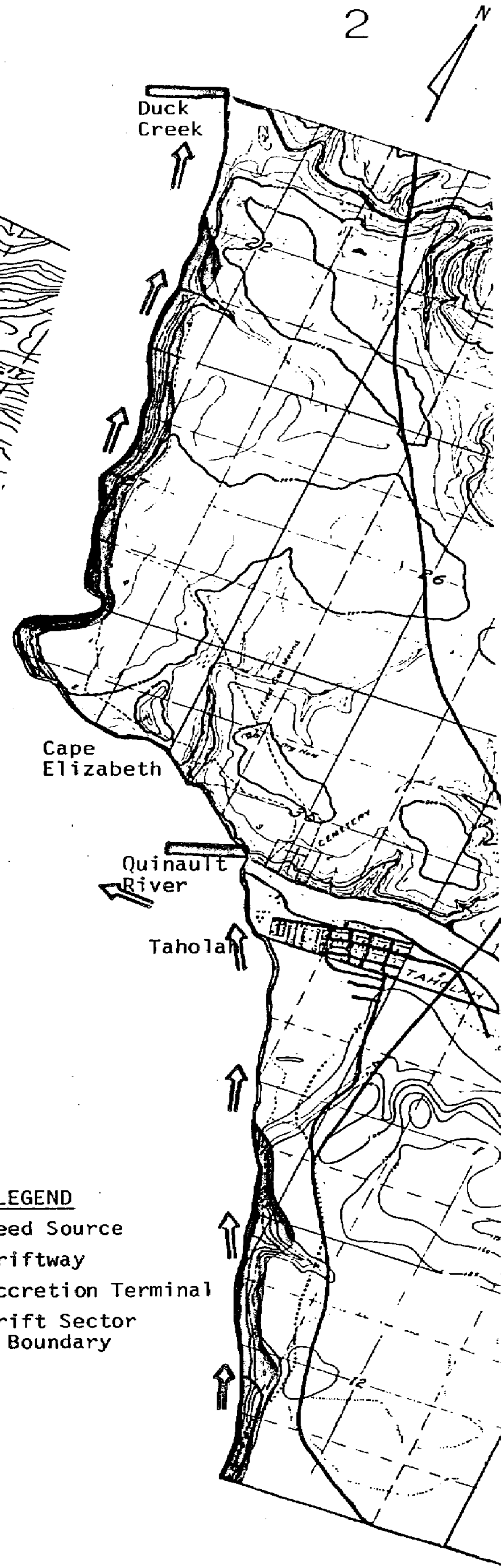
Significant onshore-offshore transport also takes place within the littoral zone due to seasonal wave action caused by variations in wind direction and magnitude. Generally, material is brought onshore during the summer and is carried offshore during the winter.

Littoral materials are stored naturally in accretion terminals such as hooks, tombolos, bars, spits, and the beach itself. They can be temporarily removed from the littoral zone by being deposited as backshore deposits. By wind and wave action they can be reintroduced into the littoral zone and they can be permanently removed from the littoral zone by being deposited into submarine canyons.

Man may create artificial accretion terminals by building structures in the intertidal zone, such as groins, jetties and bulkheaded fills.

COASTAL DRIFT





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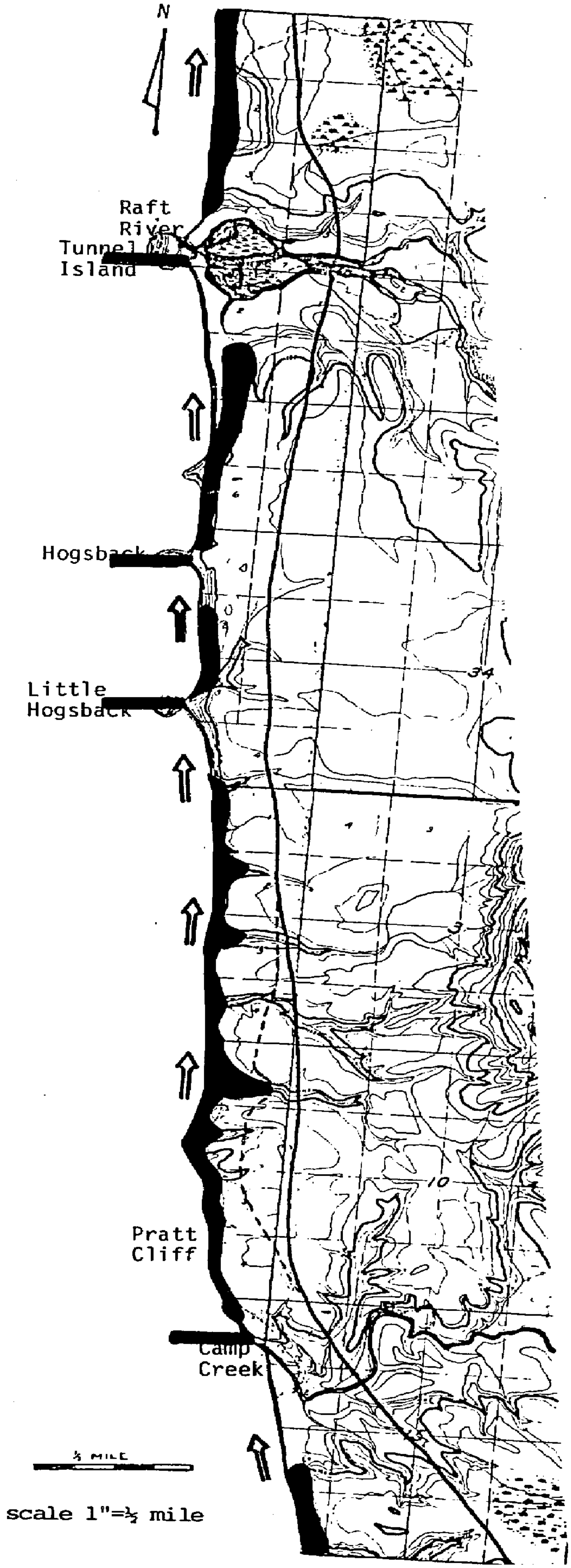
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½ MILE
scale 1"=½ mile

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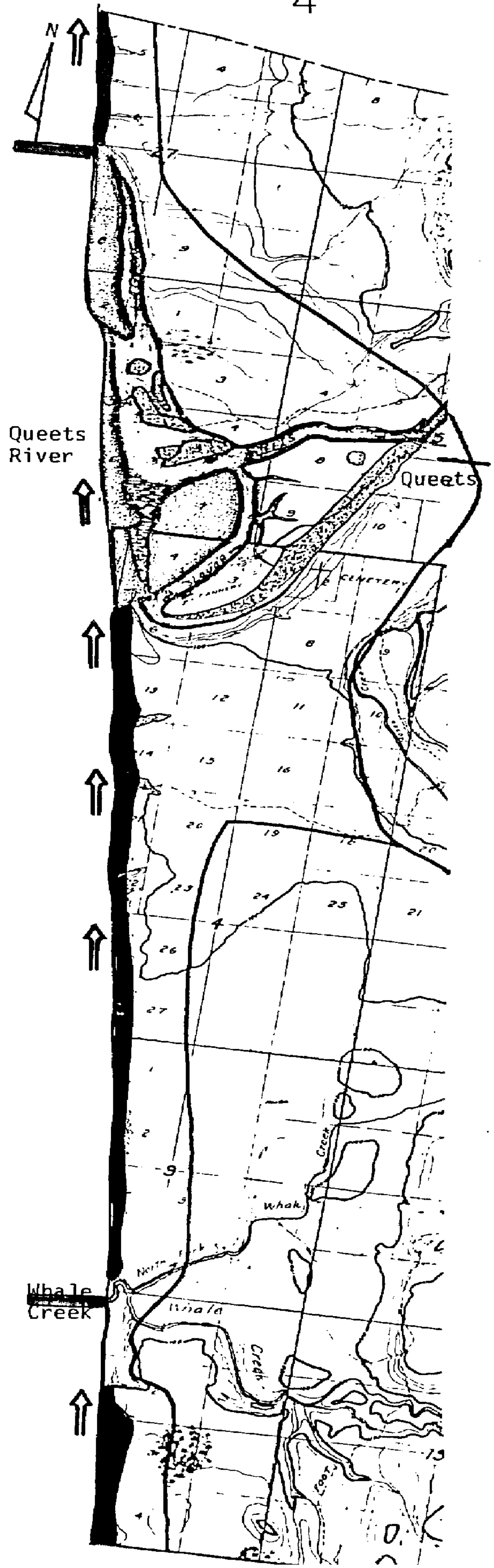
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Whale
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C. SOIL SUITABILITY FOR DEVELOPMENT

Soils provide the "working surface" of the earth upon which most of man's activities take place. Soils are derived from geologic materials of the earth modified by mechanical and chemical weathering and transporting processes. The nature of a particular soil is determined by the original material, climate, drainage, slope, vegetation cover, groundwater chemicals and many other factors acting together in time or sequentially over a period of years or centuries. Soils help determine the suitability of an area for development, roadbuilding, forest or agricultural production, and many other activities. They determine adequacy of percolation, drainage, foundation strength, and other qualities useful in coastal zone management decisions.

There are twelve classifications of soils within the coastal zone area of the Quinault Reservation as mapped and described in the "Soil Survey of the Quinault Indian Reservation,1976". The information presented here is interpretive data derived from the detailed information contained in the soil survey. It shows the suitability of the soils in each defined unit for general development involving groundbreaking activity. The twelve soils are divided into three map categories.

SOIL WELL SUITED FOR DEVELOPMENT

Soils included in this category are the Hoh, Joe, and Queets series. They are well drained, give good structural support and have a good percolation rate for septic tanks. These soils are also the most productive for forestry management, a factor which must be weighed against their use for development. Hoh soils may be subject to flooding since they are low lying.

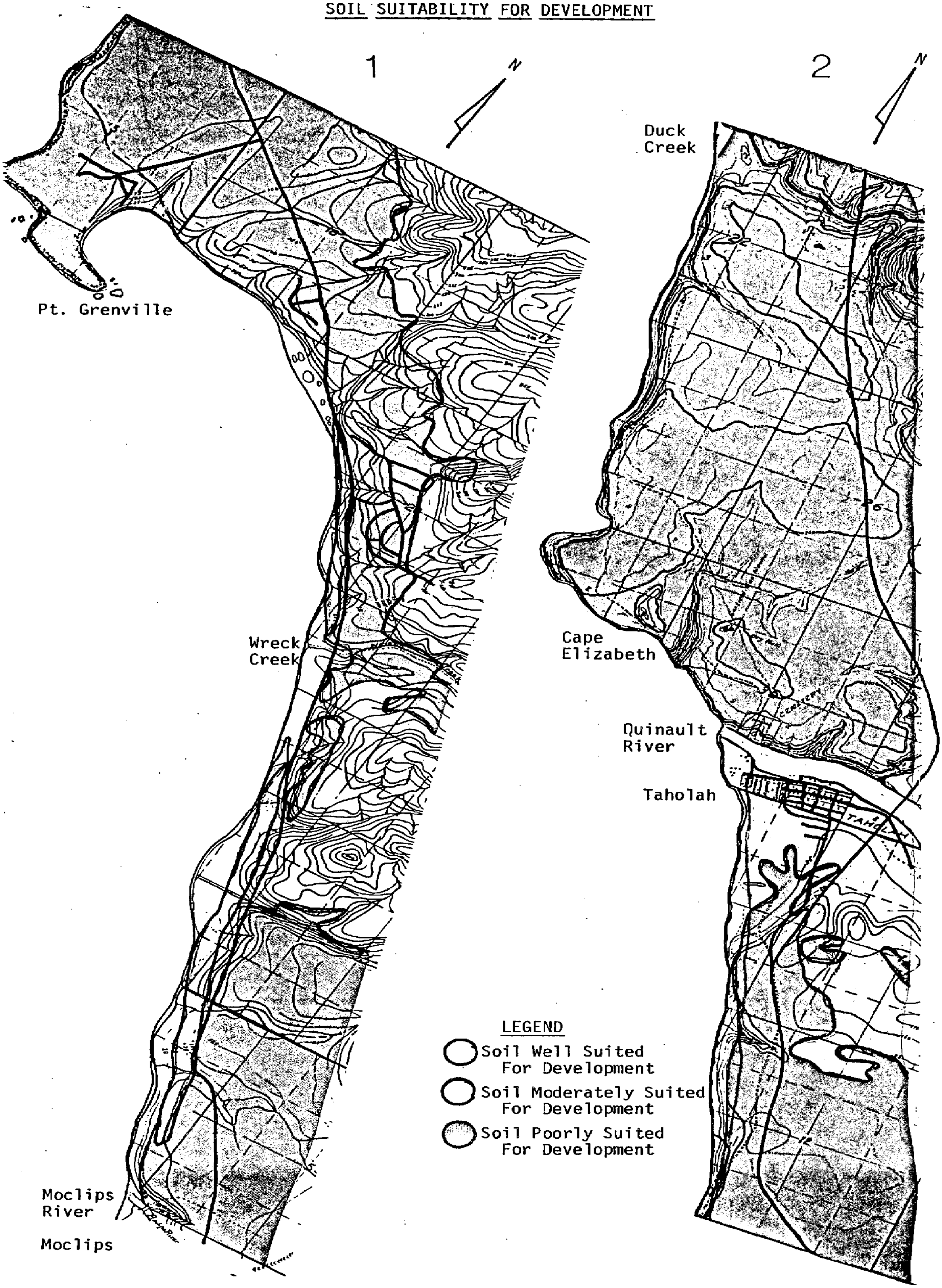
SOILS MODERATELY SUITED FOR DEVELOPMENT

Soils included in this category are the Copalis, O'Took, Quinault, Taholah, Thimble, and Westport series. These soils generally are well-drained and have good percolation rates for septic tanks. However, they are rather fine textured and may not provide adequate structural support, particularly when wet, unless additional gravel fill material is hauled in for the site. Some Westport soils may have too fast of a percolation rate for septic tanks.

SOILS POORLY SUITED FOR DEVELOPMENT

Soils included in this category are the Destruction, Pratt and Sekiu series. Destruction and Sekiu soils are composed of large amounts of clay and are characterized by poor drainage, low percolation rate and, in many places, a perched water table. They are generally not suitable for septic tanks and require additional fill to adequately support structures. Pratt soils generally occur on steep slopes and have high landslide potential.

SOIL SUITABILITY FOR DEVELOPMENT



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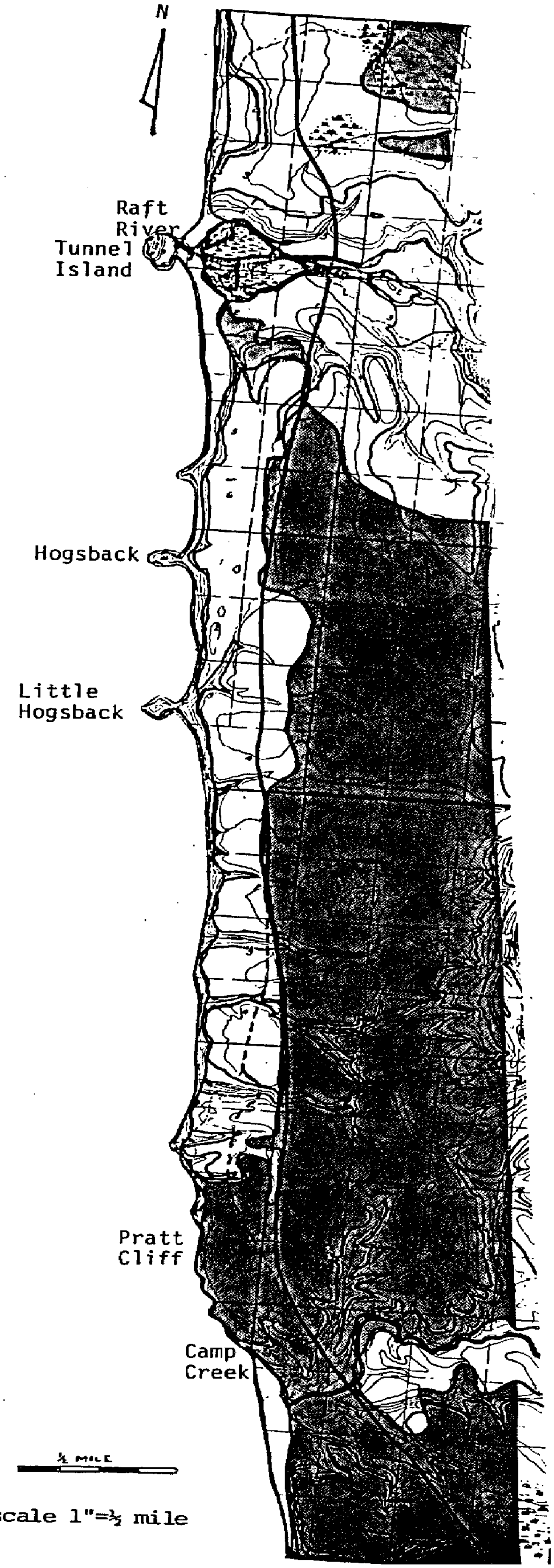

scale 1"=½ mile

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D. NATURAL HAZARDS

1. SLOPE STABILITY

Shorelines are dynamic environments where processes caused by wind, tides and gravity are active. Slope stability maps portray a relative measurement of the rapid downslope movement of earth materials. This process affects erosion and deposition in the shore environment not only at the particular site but "down drift" along the beach. There is also a feedback, wherein wave processes in turn affect slope stability on the adjoining land. Finally, as with other dynamic shoreline factors, slope stability is an important consideration in planning for the development pressures that occur in the coastal zone.

The slope stability maps present the best estimate of the stability of an area as taken from the geology and observed occurrence of past erosion, slumping and landsliding. While not definitive on a site-by-site basis, these maps can provide broad guidance for many land use decisions. They identify areas where a developer or home builder would be wise to seek individual geologic and engineering advice before making plans.

Slope stability is interpreted as the resistance to, or lack of, a tendency for landslides. The term landslide is used in its broad sense to mean the rapid (greater than one foot per year) movement of masses of earth materials downslope.

Individual data areas on slope stability maps contain local exceptions due to limitations of map scale, generalization of mapping units, or lack of information. Not all of the delineated areas were directly observed. The maps are a result of aerial photographic interpretation supported by field observations. Stable areas adjacent to unstable slopes may locally be subject to the same degree of hazard as the adjoining less stable slope. For example, a deep seated landslide in a coastal bluff may undercut the flat and otherwise stable upland. Similarly, the stable beach area may be threatened by slides from above. For such reasons these maps are not a substitute for professional site-by-site analysis in the field. Obviously, the degree of detail necessary in field investigations varies not only with the class of slope, but with the particular land use being considered.

The slope categories relate to natural conditions. Even the most stable slopes can be made unstable by poorly engineered excavations, abnormal concentrations of water, or other human induced conditions. Conversely, an unstable area can often be made relatively stable, at least locally, through drainage, buttressing, or other engineering techniques.

The slope angle of the land surface is probably the most obvious factor involved in analyzing the stability of a given area. Other factors such as materials and water being constant, a change in slope alters the effect of gravity on the tendency of materials to fall, slide, or flow downslope. However, in nature the variability of other factors may more than offset the influence of slope. Thus, a stability assessment based on slope alone can be grossly misleading. Although the angle at which various uniform materials of different moisture contents will be stable can be predicted rather accurately, catastrophic earth flows have occurred in areas of imperceptible slope where underlying marine clays have liquified. Similar materials, if well drained, may stand in vertical banks for years under different conditions and not slide. Some near-vertical "high bank" coastal areas of till are relatively stable, whereas an adjacent gently sloping "low bank" tract of different material may be the site of an ancient landslide and hence subject to renewed movement.

MATERIALS

The geologic materials making up a slope are a major factor in the behavior of that slope. (See the Coastal Geology section for a discussion of the engineering properties of geologic units). Uncohesive materials such as gravel or sand with little silt or clay "binder" will flow, even when dry, to their particular angle of repose (roughly 30-35 degrees). Materials with a high silt content such as glacial till or even some silty sands will stand near-vertical for years. Till especially can be practically immune to collapse unless undercut. Instead of collapsing, it surficially erodes slowly from frost action or alternate wetting and drying.

Slopes underlain by bedrock can have highly variable slope stability. Bedrock units may experience little or no landsliding on slopes much steeper than typical unstable slopes in unconsolidated units. However, poorly consolidated, clay-rich bedrock units may be subject to slumps and flows similar to unconsolidated units. Bedrock slopes generally experience different landslide types. Depending on the orientation of bedding and fractures within the rocks, rock slides and rock falls may occur.

Probably more important to slope stability than individual geologic units themselves are the relationships between these units. These relationships generally affect slope stability most when there is a pronounced change in physical properties between two geologic units. In areas where till overlies sand or gravel the lower unit erodes faster, undercutting the till, which eventually collapses as large blocks. Where sand overlies till, silt, or some other relatively impermeable material, the infiltration of groundwater is slowed and a perched water table forms locally within the sand unit. This saturated zone represents a layer of weakness that commonly results in slumping and mud flows.

ROCK STRUCTURE

Due to the mode of deposition or subsequent geologic modification, many rock types possess discontinuities such as bedding planes, joints, foliation, and shear or fault zones that are significantly weaker than the rock mass taken as a whole. Deformation of the earth's surface by geologic forces has acted to uplift, shear, tilt, fold, and break rock materials. Such deformation and subsequent erosion often results in weak zones which are prone to sliding.

The orientation of bedding planes and weak zones is critical to surface failure. The presence of exceptionally weak beds such as shale or volcanic ash within stronger rocks can contribute significantly to the potential for sliding along bedding planes when those planes are inclined toward a slope. Foliation in metamorphic rocks and joint planes dipping into a valley can develop similar slide conditions. Freezing and thawing of water in near-surface joints often leads to a rockfall of individual blocks of rock. Shear or fault planes inclined toward a slope can create a landslide in a manner similar to other inclined zones of weakness. If shearing or faulting produces relatively wide zones of material weaker than the unsheared rock, a landslide is more likely to develop on a slope where such weaker materials exist. In areas where weak rock structures are more steeply inclined than the slopes, landslides are generally much less frequent than where adverse orientation exists.

Rock structures can also have a significant effect on how groundwater will accumulate and move. Alternately permeable and impermeable inclined beds can result in groundwater entrapment and great hydrostatic pressures within the ground. These pressures can reduce the resistance of materials to shearing and lead to landsliding.

WATER

The presence of water available to percolate into the ground and through earth materials plays an important role in the relative stability of slopes. Generally, the availability of water is a function of local climate; therefore the types of landslides and their relative activity and frequency varies from wet to dry climates. In much of western Washington, precipitation is high. During the rainy season there is little or no evaporation; thus much of the water infiltrates the ground and forms various zones of saturation within the sediments and rocks. The movement of the water and the number and location of saturation zones (aquifers) are controlled by the types of earth materials. The strength of earth materials changes drastically once they are saturated with water. When types of material, slope, and water combine in such a way that the vertical force of the weight (due to gravity) is greater than the strength of the saturated materials, a landslide occurs.

Natural groundwater levels can be significantly altered by human activity, especially on a local setting. The diversion of storm runoff is a common cause of abnormally high infiltration rates in a relatively small area. Septic tank effluent can also have a profound effect on local groundwater conditions and thus slope stability. In a new residential development such effects may not fully develop for many years.

WAVE EROSION

In a broad sense, the coastline can be grouped into actively eroding and actively accreting shoreforms. The effects of the shore alignment processes on slope stability are variable (because of other factors), but profound. The most important effect of wave erosion on coastlines is that wave action steepens and undercuts slopes and prevents stabilizing debris accumulation at the toe of slopes, thus ensuring continuing erosion. High strength materials like till are unstable where such active erosion occurs.

On the other hand, areas of beach accretion provide protection for coastal slopes. New, stable slope angles and mass balances can be achieved where erosion has essentially stopped. Although the effect of groundwater on earth materials can still render a protected coastline face unstable, generally slopes behind accreting beaches will be more stable than slopes behind eroding shorelines.

The interplay between materials, groundwater, and shore processes forms a system in which the configuration of the coastline and slope stability are a result of the combination of several factors, and the feedback from one process to another. For example, landsliding coupled with active wave erosion can provide sediment for transport along the shore and accretion elsewhere. The accreting shore in turn will protect adjacent upland slopes from erosion and will probably reduce landsliding.

OTHER FACTORS

The environment during the time when the sediments were deposited and the influence of post-depositional events (geologic history) can have a profound effect on the strength of slope-forming materials.

Knowledge of any former slide movement can be critical in assessing the long-term stability of an area. An ancient landslide is an area of disturbed materials and groundwater conditions even though it may not have moved for centuries or even thousands of years. Such an area can be fairly stable in its natural state. Yet it may respond differently than adjacent slopes of the same materials to excavations or changes in groundwater.

Human activities can modify any of the above factors. Artificial cuts steepen slopes. Artificial fill changes the load and character of materials on slopes. Septic tank drainfields increase infiltration. Although the effects of these modifications may be unpredictable, commonly they reduce slope stability. On the other hand, engineering techniques such as artificial draining of water-bearing strata or the decrease of rainwater infiltration by paving and appropriate storm drains can increase slope stability. On-site investigations of intermediate and unstable areas, coupled with suitable land use planning, are a prerequisite for a sound balance between hazard to life and property, cost of land improvements, and real estate values.

SLOPE STABILITY CATEGORIES

Unstable - These slopes are considered unstable because of geology, slope, groundwater or erosional factors. They show evidence of recently active landsliding.

Potentially Unstable - These slopes are considered to be potentially unstable because of one or more of the factors listed in the unstable category above. They show some evidence of landsliding at some time in the past, but do not indicate recent activity. It is likely that human modifications could easily make these slopes unstable.

2. COASTAL FLOODING

The processes responsible for flooding of marine shorelines individually or in combination are extreme high tides, waves generated by winds, tsunamis of distant origin, and locally generated seismic waves or boils. They may appear singly or in combination. By far the most likely and recurrent form of coastal flooding on the Quinault Reservation is by wind waves superimposed on extreme high tides. Tsunamis, though infrequent, are an extreme hazard to the beach areas along the open coast. Some Quinault legends tell of huge waves and floods in the past which were probably tsunamis. The tsunami generated by the Alaskan earthquake of 1964 damaged areas of the coast south of the Reservation. Although the wave was noticed at Taholah, the town was protected from its effects by Cape Elizabeth jutting into the ocean on the north. A wave from a different direction could have been a different story.

Access to the waterfront is a prime advantage in developing low-lying shores such as that of Taholah or Pt. Grenville bay. Homes located on top of bluffs afford spectacular views, but without a dry beach at all tide levels waterfront activities such as beachcombing are limited. Hence in those areas where at least some dry backshores exist there will be increased pressure for development. These same low-lying beaches are most susceptible to the processes which cause flooding.

Land forms frequently prone to flooding are points, spits, pocket beaches, tombolos, and berms in conjunction with a low backshore. In these areas, accretion is commonly in progress or the shoreline, following a period of accretion, has stablilized producing a backshore. The most significant feature of a wide backshore is a naturally occuring storm berm such as the strip of land between Long Pond and the beach at Taholah. Under extreme conditions, storm waves superimposed on high tides can overtop a high storm berm and even destroy it. The area lying behind may then become inundated by rising sea levels either in the form of flowing or still waters.

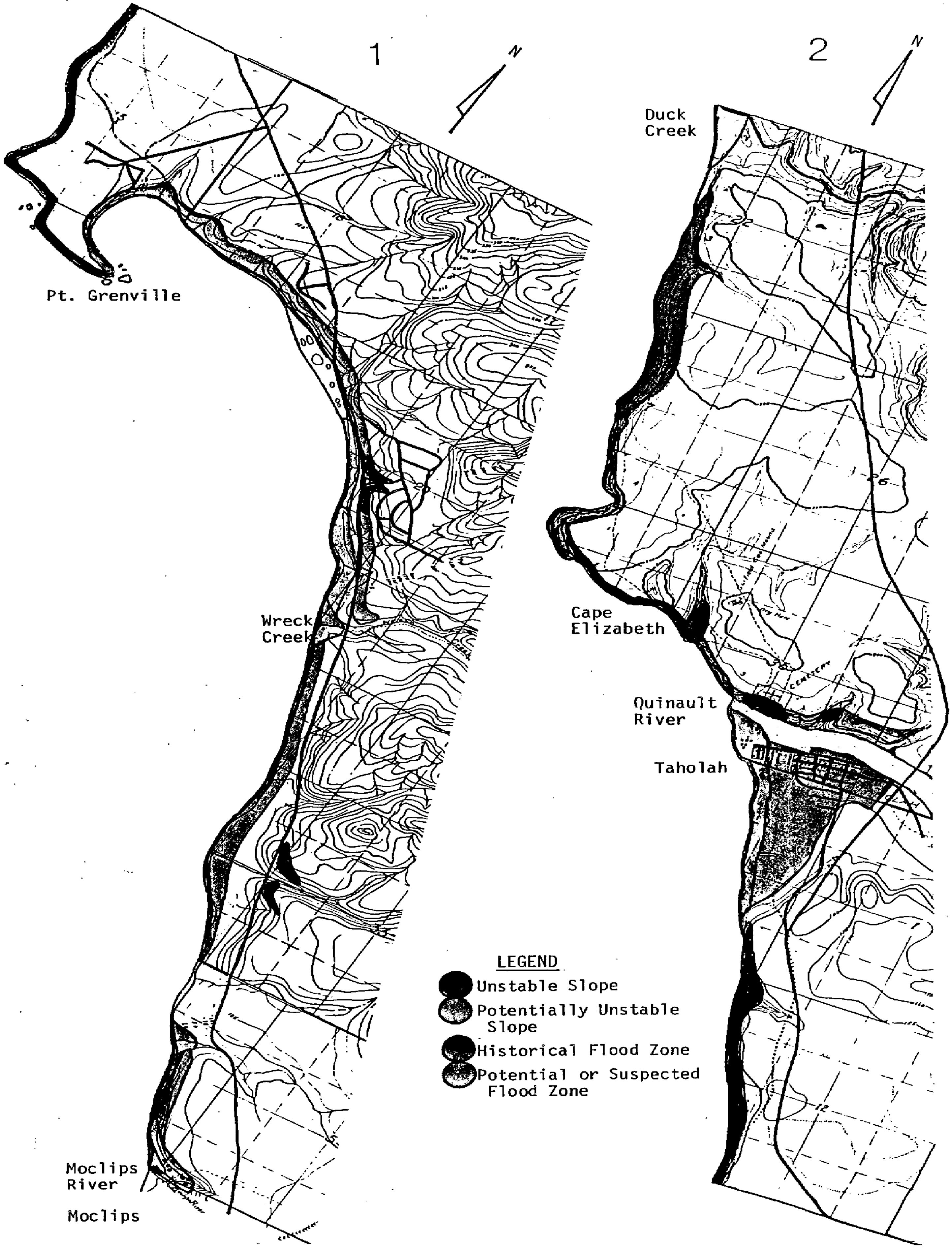
Generally, homes set behind a berm are relatively protected unless extreme high wave action or storm waves from an abnormal direction breach and erode the protective shoreform. Once this barrier has been lowered and is overtopped, further encroachment may continue even at less than extreme water levels. Often, return to normal weather patterns will eventually allow rebuilding of the berm, provided man has not adversely altered the natural restoration capacity of the shoreline. Often associated with storm damage is the additional hazard posed to structures by wave-tossed logs and debris.

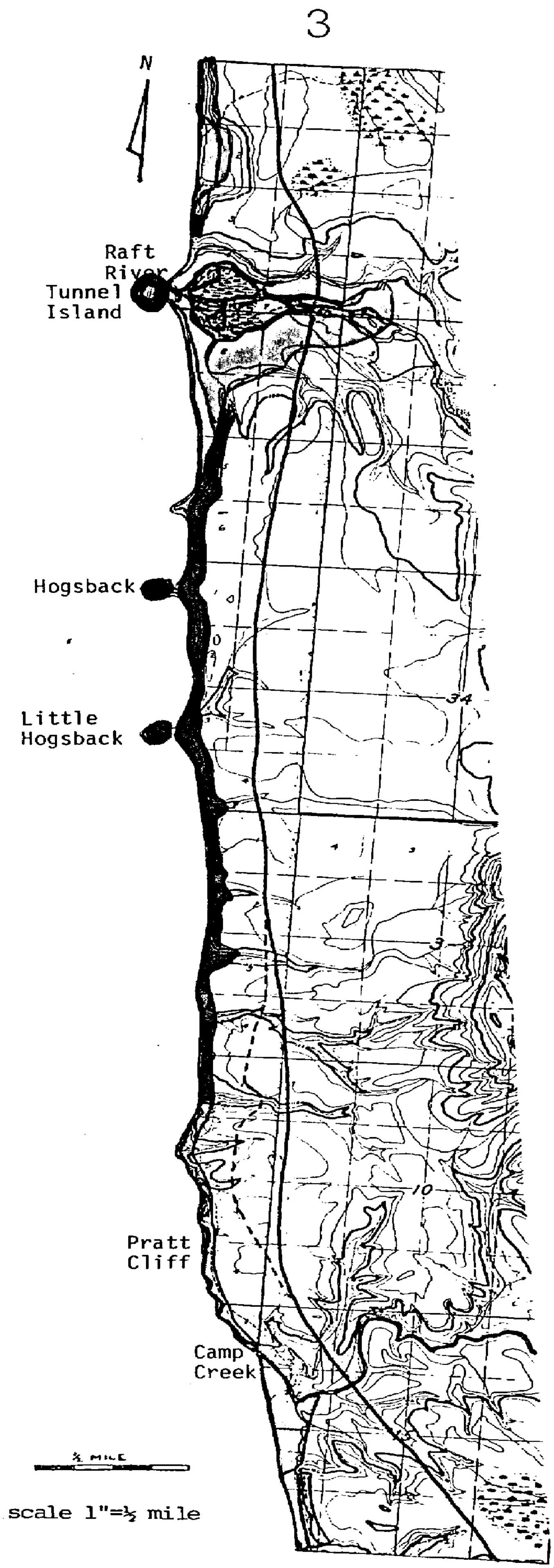
The following classifications are used to designate areas subject to coastal flooding.

HISTORICAL FLOOD ZONES are those coastal areas where residents have recalled prior flooding or where physical evidence of prior flooding exists.

POTENTIAL OR SUSPECTED FLOOD ZONES are those areas where flooding may occur or the physical setting suggests that flooding may have occurred but direct physical evidence is not available. Narrow flood-prone beaches at the bottom of steep banks or cliffs are omitted due to scale limitations of the maps.

NATURAL HAZARDS

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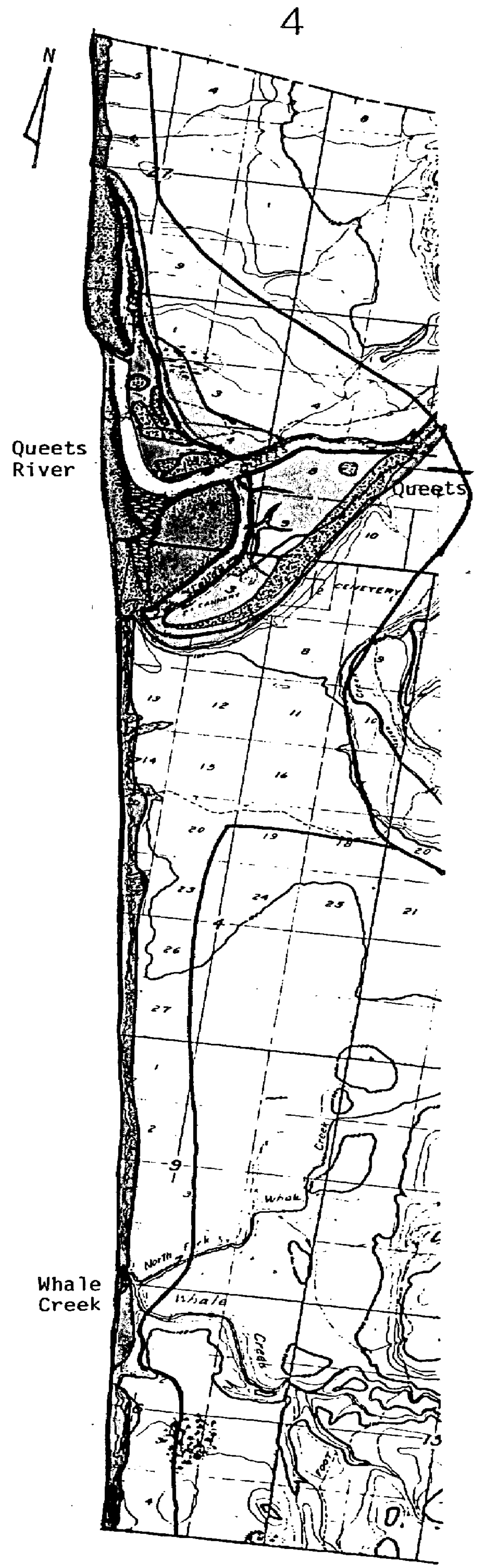
scale 1"=½ mile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CEMETERY
Whale
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North Fork
Whale
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E. CRITICAL BIOLOGICAL AND SCENIC AREAS

Critical biological areas are designated here as areas necessary to the survival of an economically valuable species or to a species which is listed as threatened or endangered; or the area is used as a key part of the life cycles of a large number of different species. These areas are sensitive to human uses. Uncontrolled and unregulated activities or land uses may cause the species involved to decrease or disappear from the Reservation's environment.

There is presently a great lack of data concerning the occurences and needs of most wildlife species in the coastal zone. As more information becomes available from future studies other areas may be designated as critical biological areas.

RAZOR CLAM BEDS

The commercially valuable razor clam beds on the Quinault Reservation lie on the 4½ mile stretch of beach south of Pt. Grenville. There are other beds in the vicinity of Raft River and Hogsback, but these are much smaller in extent and more difficult to get to. They are used mostly for sport digging, although some minor commercial digging may occassionally be done.

Razor clams spawn within a period of a few days during May. Spawning is controlled by water temperature and begins when the temperature increases to approximately 55^{0} F.

The clam larvae can be free swimming for up to 8 weeks, but usually set in the sand much sooner than that, which prevents them from becoming widely scattered. Once past the larval stage razor clams remain in one place for the rest of their lives, having only an up and down movement capability. Using up and down movements they generally can keep pace with the constantly changing level of beach sand. It seems likely that during extreme sediment movements such as during storms young clams which have previously set may be moved to new locations with the other beach sediments. Razor clams are restricted generally to the littoral zone; seldom being found at a water depth of over 12 feet.

The clams reach sexual maturity at about 3 years and can live to about 9 years of age. If the clam harvest rate is greater than the rate of replacement it may be first indicated by two factors: (1) the average size of the clams being dug decreases; and (2) the average number of pounds per digger decreases.

Razor clam beds may be damaged by removal of beach sand either directly or by interruption of the littoral drift chain which constantly replenishes it. Vehicles, horses and construction equipment can also damage the beds by crushing the young clams in sand. Fine sediments such as silt deposited on the beach can destroy the clams by smothering them. It seems likely that the clam beds would be susceptible to oil spills, as well, either being smothered or affected by the petroleum chemicals.

Although the razor clams in this area have historically not been subject to red tide there could be some potential for damage. Red tide organisms have been associated elsewhere with increasing levels of water pollution from human activities. Although the red tide does not kill shellfish it makes them unfit for human consumption for a period of time and decreases the marketability of the unaffected clams.

ESTUARIES

Although the estuary areas of the Quinault Reservation are rather small they are important for two reasons: (1) Salmon and steelhead become concentrated and must pass through the estuary in order to get to their upstream spawning grounds; and (2) Estuaries serve as the interface between the marine, freshwater, and land environments and thus provide a habitat for a large number of wildlife species. The various species of salmon pass through the river estuaries during the following time periods on their way to the spawning grounds:

Chinook - April through November
Coho - October through November
Sockeye (blueback) - April through June or July
Chum - November
Steelhead - December through March

After hatching in the spawning areas the young salmon must pass through the estuary on their way to the sea. Estuary water quality is particularly vital during this time to insure maximum survival of the young salmon. The young of the various species are in the estuary areas during the spring and summer.

A great many wildlife species spend at least part of their time in the estuary environment. River otters and seals are particularly dependent on it as are a number of bird species.

OFF-SHORE ROCKS AND ISLANDS

The numerous off-shore rocks and islands are important because of the protection they provide a great number of birds from predators and human disturbance during the nesting season. They also provide relatively safe resting sites away from human interference for seals, sea lions, and sea otters (an endangered species).

BALD EAGLE NESTS

Bald eagle nesting sites are located at approximately 4 mile intervals along the Quinault Reservation coastline with 5 nest sites presently known, each supporting a pair of adult eageles. Bald eagles require nest trees to be mature live, green trees with sufficient limbs in the upper portion to support their large nest. They will generally select the largest stoutest tree in an area for the nest. Along the coast this is usually a sitka spruce. The nests are usually located about two-thirds of the way up the tree and partially sheltered by limbs above which are also used as perches. A pair of eagles may have more than one nest. If there are 2 or 3 nests they are usually located in the same general area and are used during alternate years. There may also be one or two other trees in the same area which are used as perch trees. These provide a good view over the area and may be large, dead, though firm, snags or live spike top trees. A pilot tree is usually the closest dominant tree to the nest site. It has the same characteristics as a perch tree, but is used specifically as an access point to the nest.

The nesting period of bald eagles on the Quinault Reservation begins around the first of February and lasts until about August, when the young eagles leave the nest site and begin fending for themselves. The nesting period is an extremely critical time for eagles.

Human activity in the vicinity of the nest site can be extremely disturbing to the nesting pair and may cause them to abandon the nest and not produce young during that year.

For a viable bald eagle population to remain in an area a certain amount of new habitat suitable for nest sites must remain available to replace old habitat which comes to be no longer used due to removal of trees, non-availability of food, or increased human activity. Some mature trees need to be preserved for nesting sites in the future.

The United States Fish and Wildlife Service has proposed specific guidelines concerning rules and regulations concerning human activities in the vicinity of bald eagle nests, but their legal application on the Reservation is primarily up to the Tribal government.

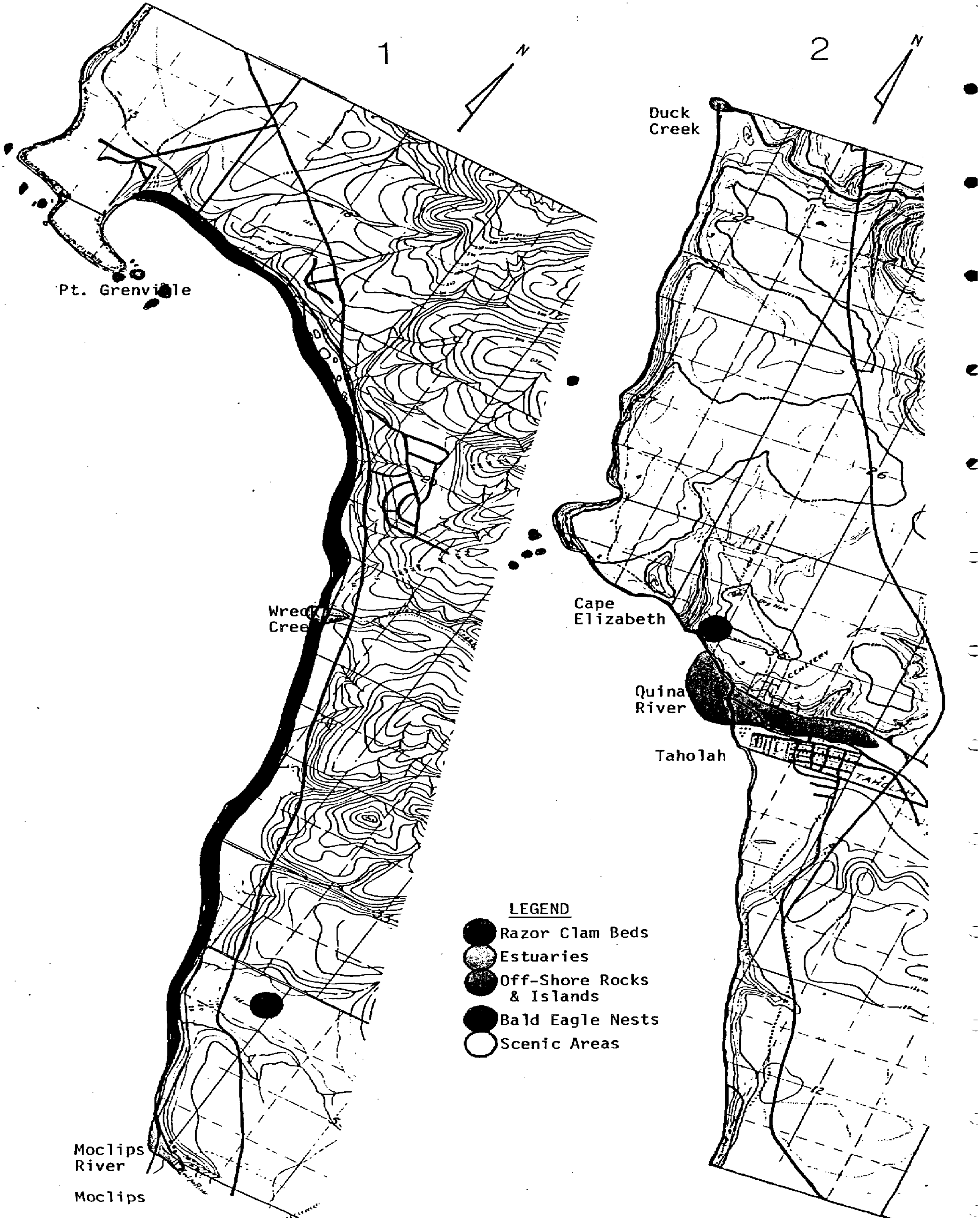
SCENIC AREAS

In a sense the whole coastline of the Quinault Reservation, with its broad beaches, unique rocks, abundant wildlife and soaring cliffs, is a scenic area. The places designated here as scenic areas are those which particularly stand out within the overall beauty of the whole coastline. Scenic value is difficult to quantify, although certain techniques are gradually being developed. At the present time the designation of scenic areas is done pretty much on a subjective basis, supported by a review of areas appearing in published photographs, talking with local residents, and conducting field examinations.

The scenic value of a particular area may be degraded by concentrated human activity or certain land uses. If a large part of the scenic value of an area depends on its natural setting, which is the case here, then artificial human structures or developments unless sensitively designed and built will decrease that scenic value. Individuals seeking to obtain maximum personal use of the scenic values can actually decrease the scenic value to all other users substantially by building homes, cabins or campsites within view of the area.

The areas designated as scenic areas are: Pt. Grenville and Pt. Grenville Beach, Cape Elizabeth, Big and Little Hogsback, and Tunnel Island.

CRITICAL BIOLOGICAL AND SCENIC AREAS



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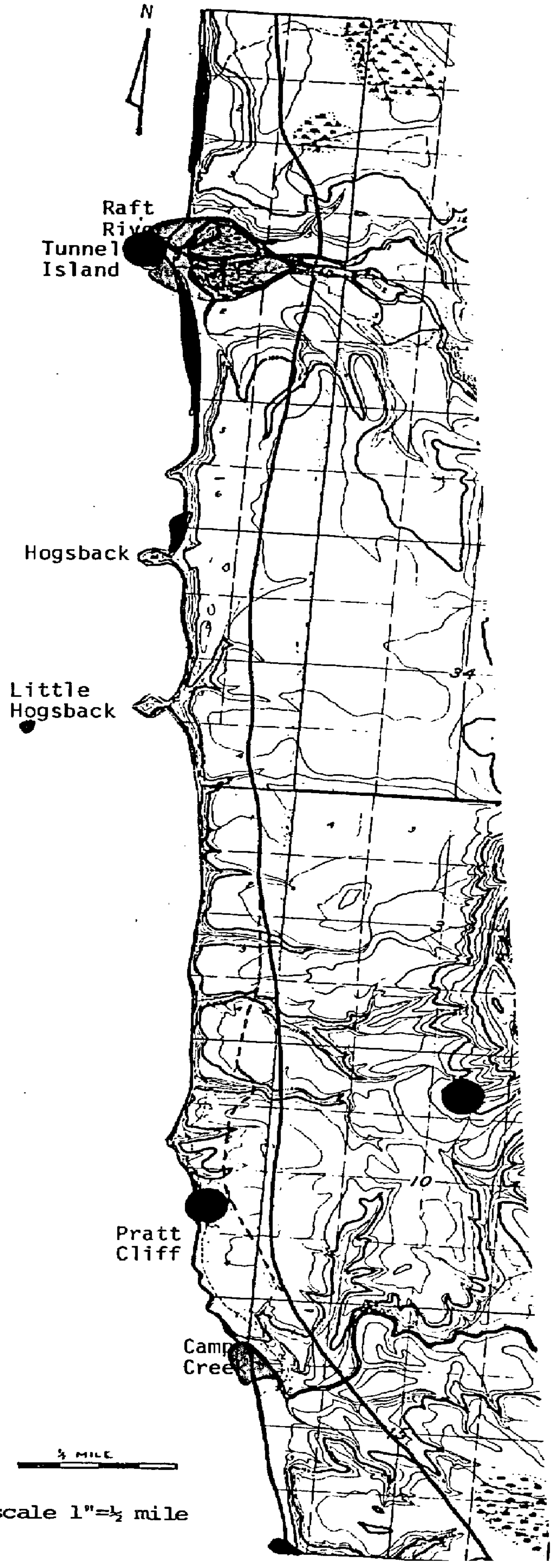
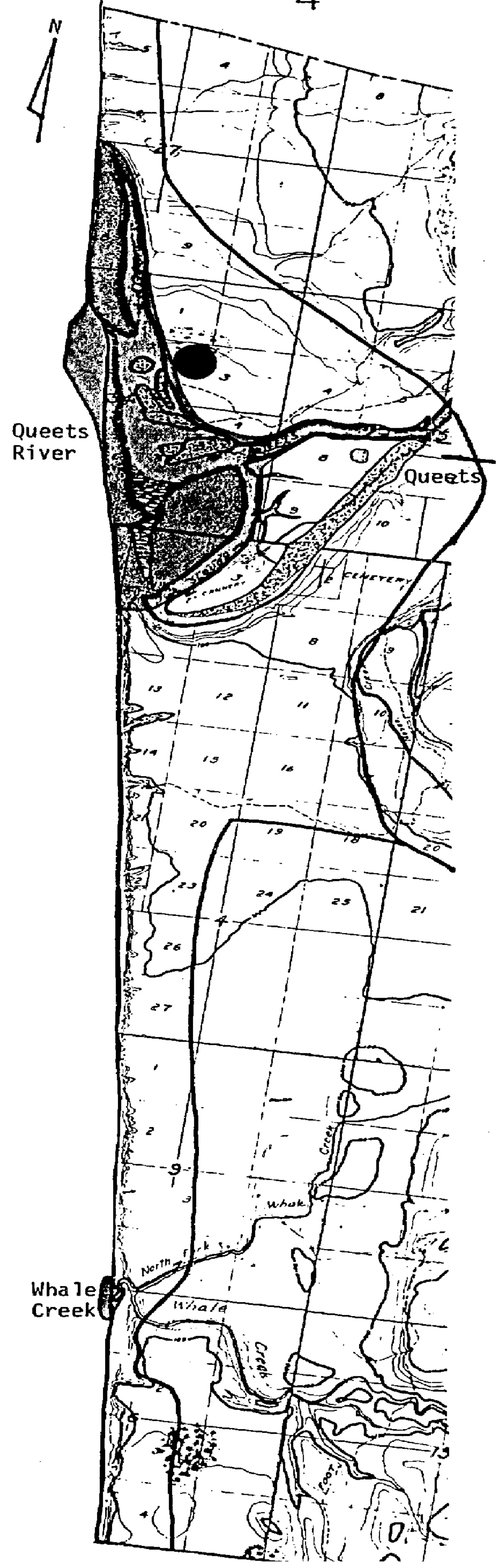


scale 1"=½ mile

4



F. LAND COVER / LAND USE

The land cover and land use maps show the cover and use as of May 1978 of the upland areas in the coastal zone of the Quinault Reservation. They provide base data which in future years will show trends in changing land uses. Also, by understanding the potential uses of certain types of land cover, predictions can be made about locations and what types of use pressures will develop in the future. For example, it is likely that pressure will develop (if it has not already) to harvest any economically valuable stands of timber remaining in the coastal zone. Wildlife habitat can also be generally determined from the information presented. At least preliminary determinations concerning the type and numbers of species liable to be present can be made.

The following categories of land use and land cover are represented on the maps.

RESIDENTIAL AND COMMERCIAL AREAS

These areas are the developed townsites of Taholah and Queets. Outside of the townsites the locations of houses and cabins are shown individually.

FOREST PRODUCT INDUSTRIAL AREAS

The only forest product industry presently in the coastal zone is the Quinault Tribal Shake Mill at Taholah.

FORESTS OF HIGH COMMERCIAL VALUE

These areas are primarily old growth stands of cedar, spruce, hemlock and fir which can be economically harvested.

FORESTS OF MARGINAL COMMERCIAL VALUE

These areas are old growth stands of cedar, spruce, hemlock, and fir, but due to poor growth factors of soil, drainage or disease the trees are of small size, deformed or otherwise not harvestable at a profit. They may be valuable to wildlife as refuges when nearby commercial forests are harvested.

SECOND GROWTH FORESTS

These are stands of even aged trees created by previous clearcutting and which are now approaching or have attained commercial size.

CLEARCUT AREAS

These areas once contained commercially valuable forests which have been clearcut in the recent past. With proper reforestation and management these areas will produce a new generation of trees for the future. A common characteristic of clearcut areas in the coastal zone is the large amount of slash which is usually left on the land. This material is presently a great hindrance to planting and proper management of the new forest.

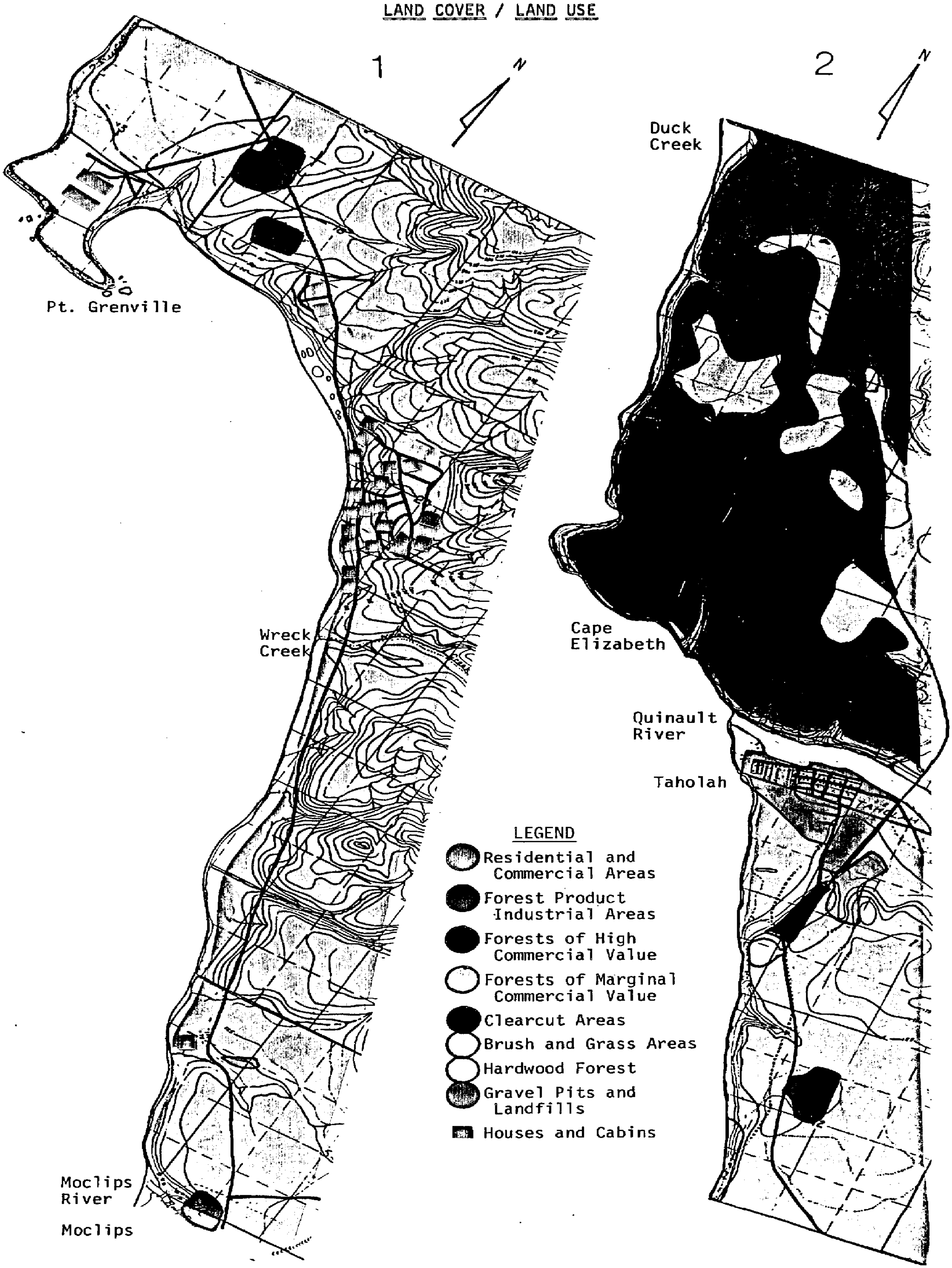
BRUSH AND GRASS AREAS

These areas contain few or no trees due to soil conditions, drainage or past inadequate forest harvest and management practices.

HARDWOOD FOREST

These areas contain predominately red alders. Their presence is due to soil conditions, drainage, or inadequate reforestation and management after harvesting the commercial species in the past.

LAND COVER / LAND USE



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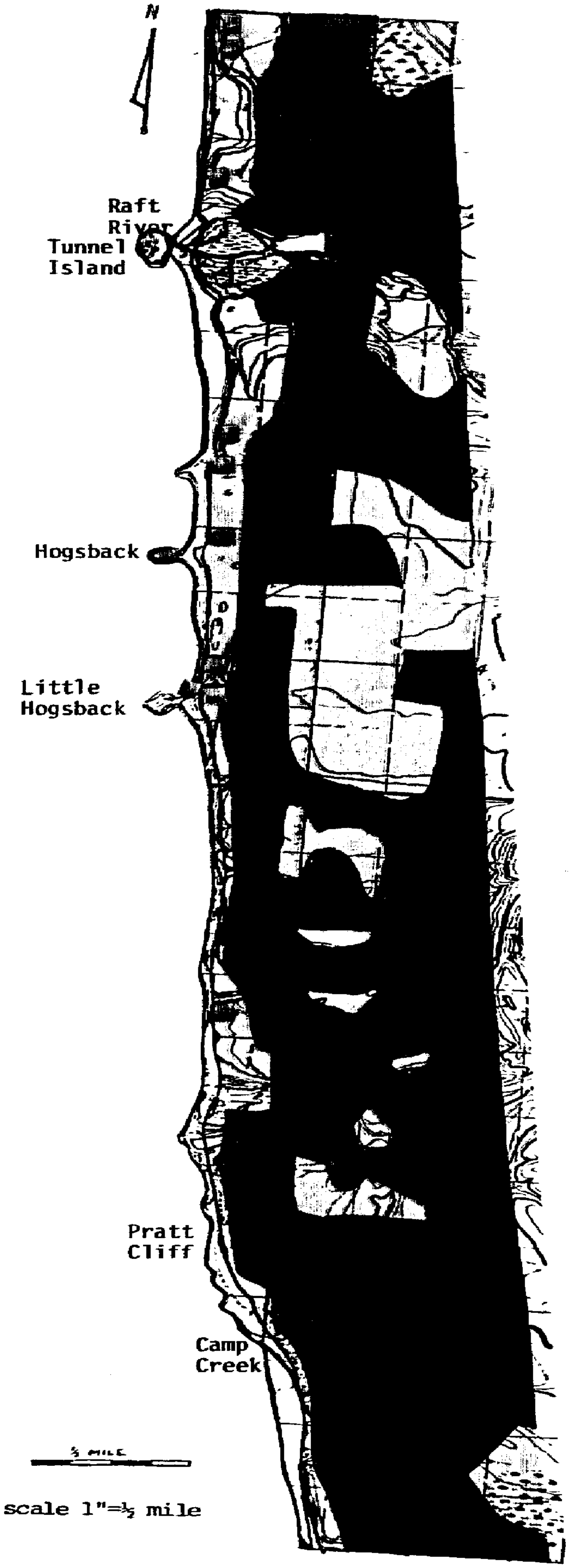

N
Raft River
Tunnel Island
Hogsback
Little Hogsback
Pratt Cliff
Camp Creek
scale 1"=½ mile

4


N
Queets River
Whale Creek

G. LAND OWNERSHIP AND COASTAL ACCESS

Used with the land cover / land use maps land ownership maps can provide useful insights into developing pressures for future uses of coastal zone lands and resources. Land ownership is divided into three categories: Tribally owned land, trust land, and fee patent land. The owners in each category have certain general interests in common and can be expected to want to use their coastal land and resources in the ways described below.

TRIBALLY OWNED LAND

The Quinault Indian Nation is attempting to use the land it owns in the coastal zone for the long term benefit of its members. That benefit is best served by a multiple use approach which provides economic goods and uses, but just as importantly, also provides for a continuation of the spiritual, social, and cultural factors of Quinault life through a preservation of the natural coastal environment.

ALLOTTED TRUST LAND

Allottee landowners use their lands primarily for timber production to provide economic benefit to themselves. There has been some interest to use a few areas for primary and recreational homesites for the personal use of the allottee, but little actual development has occurred. This land is generally not subject to subdivision and development due to the limitations imposed by the trust relationship with the federal government.

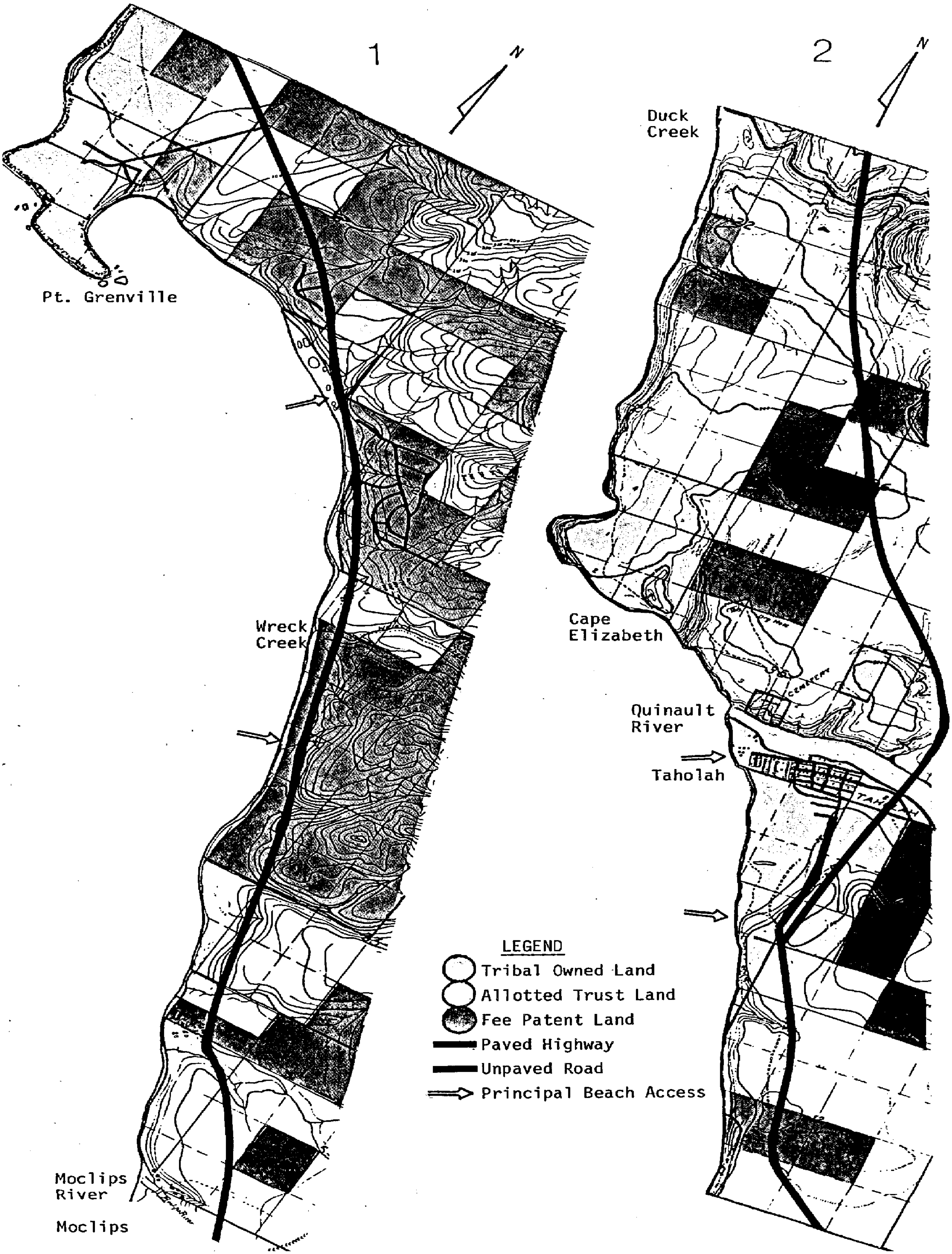
FEE PATENT LAND

Fee patent land owners generally purchase coastal land for the purpose of deriving income from timber production or to subdivide it for residential or recreational development, sometimes for both purposes. If the land is subdivided and sold the secondary purchasers typically are concerned with preservation of the natural environment even though they are contributing directly to its overall degredation by their individual developments. Although they do not do so intentially, and they may even sympathize with Quinault goals, these purchasers threaten the Quinault cultural and social system by their very presence.

COASTAL ACCESS

Access is an important factor in determining how intensively the coastal zone of the Reservation is used. Except for the areas south of Taholah and north of Queets access to the coastal zone is only by poorly maintained logging roads. Paved and unpaved access roads are designated on the maps. The major places which are used for access to the beach are also shown.

LAND OWNERSHIP AND COASTAL ACCESS



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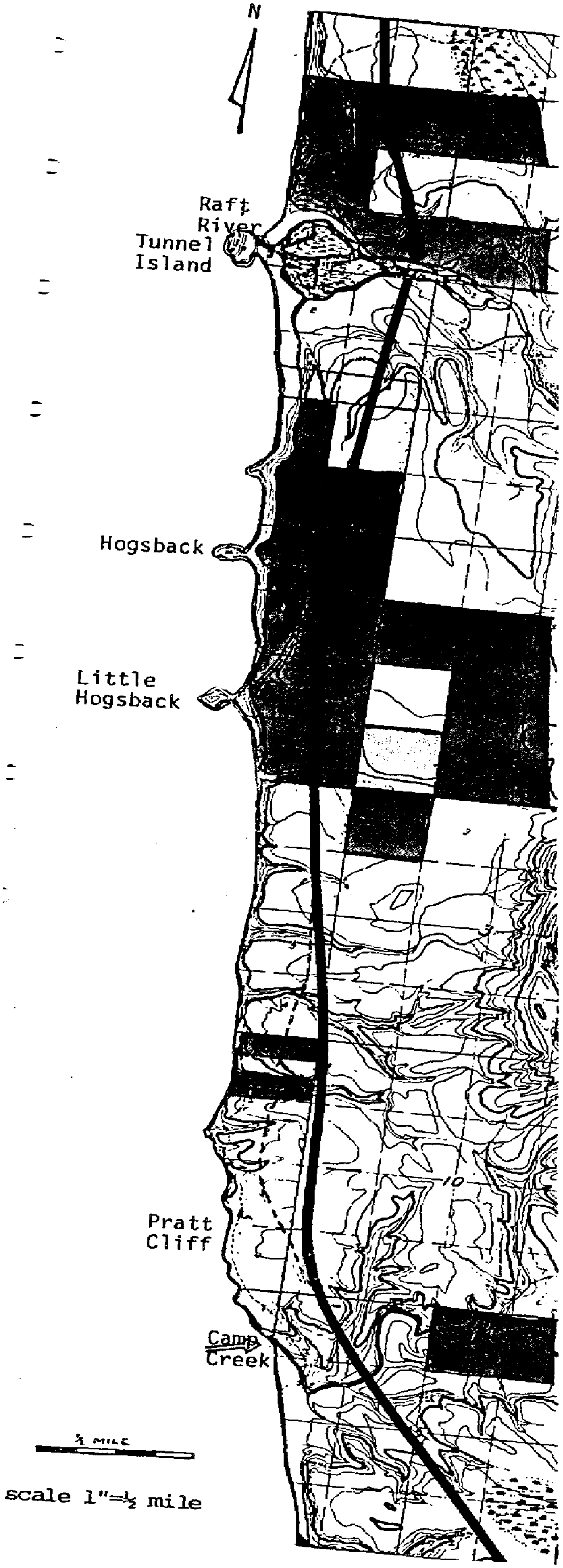
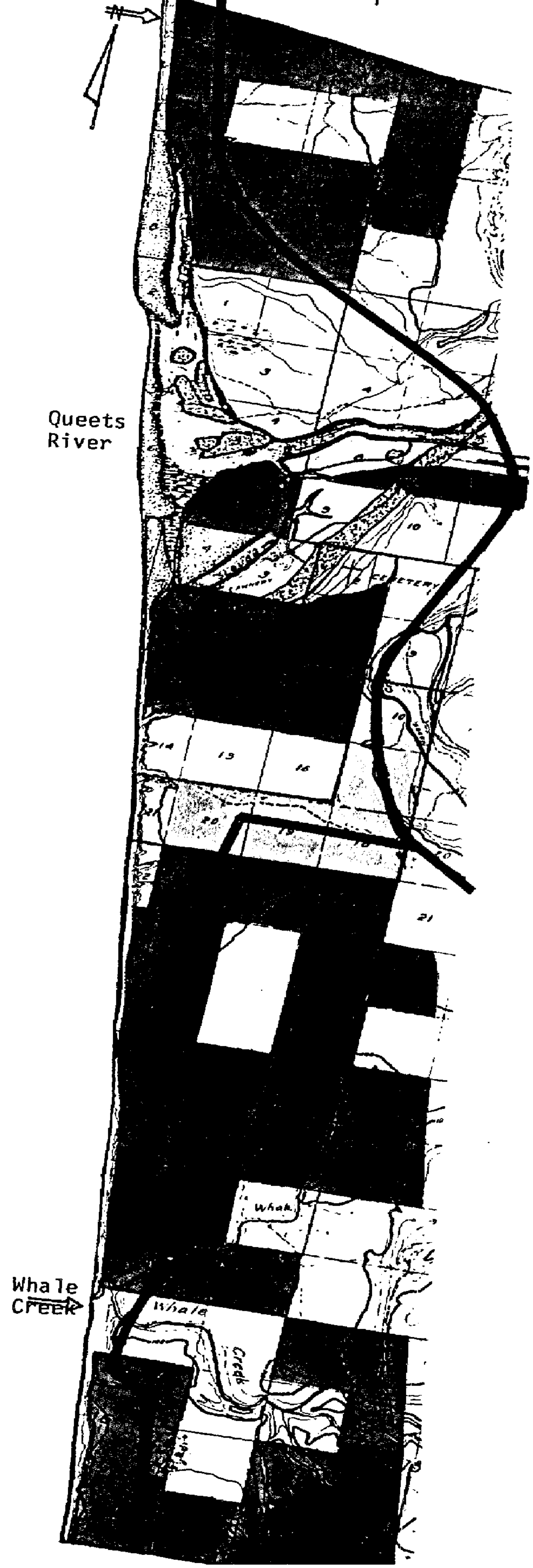

N
Raft River
Tunnel Island
Hogsback
Little Hogsback
Pratt Cliff
Camp Creek
½ MILE
scale 1"=½ mile

4


N
Queets River
Whale Creek

PART III - QUINAULT COASTAL ZONE MANAGEMENT POLICIES

GENERAL POLICY - The Quinault Indian Nation recognizes the coastal zone as one of its most valuable environmental, economic, cultural and social resources and that a comprehensive and coordinated program of management is essential to prevent damages resulting from uncoordinated and piecemeal development. The coastal zone is viewed as an interrelated natural unit irrespective of ownership, jurisdictional claims, or individual goals or policies. The coastal zone will be managed in all its aspects to provide for the maximum overall benefit to the Quinault Indian Nation.

POLICY #1 - The Quinault Indian Nation asserts its governmental managerial jurisdiction over all lands, both trust and fee patent, within the boundaries of the Quinault Reservation.

POLICY #2 - The Quinault coastal zone management program will be coordinated as much as possible with the coastal zone management programs of the political jurisdictions adjacent to the Quinault Reservation. This policy shall not infringe upon the sovereignty or power of the Quinault Indian Nation to manage the coastal zone in its best interest.

POLICY #3 - Full public discussion and opinion shall be sought and considered in the development of the Quinault coastal zone management program.

POLICY #4 - No projects or activities which affect any portion of the coastal zone drift sector will be permitted until an adequate study is carried out to provide a full understanding of the consequences to other parts of the beach area. Such projects or activities include artificial jetties, groins, breakwaters, bulkheads, sand and gravel removal, dams, and coastal bluff erosion control projects among others.

POLICY #5 - The Quinault Indian Nation recognizes a responsibility to protect life and property on the Reservation. Therefore, no development in the coastal zone will be permitted which would create a potential hazard to persons or property due to poor slope stability or coastal flooding.

POLICY #6 - Soil characteristics shall be taken into account in planning for development in the coastal zone. No development will be permitted unless adequate foundation support strength, drainage, and percolation exists or can be adequately provided.

POLICY #7 - Razor clam beds are a major economic resource of the Quinault Indian Nation and will be managed to provide the greatest long-term economic benefits. No project or activity which would lessen or threaten the economic value of this resource will be permitted.

POLICY #8 - The estuaries of the Quinault coastal zone are recognized as critical areas to both commercial fish species and wildlife. No project or activity which would be detrimental to the salmon and steelhead resource will be permitted. The wildlife habitat value of estuary areas will be maintained and considered in the planning of any project or activity affecting the estuary environment.

POLICY #9 - Offshore rocks and islands will be maintained as bird and wildlife sanctuaries free from human disturbance except by tribal authorized regulations.

POLICY #10 - Threatened and endangered wildlife species will be protected. Suitable habitat for both the present and future needs of these species will be preserved.

POLICY #11 - The visual quality of the natural scenic areas of the coastal zone is recognized as an important asset. Developments near these areas will be limited and where permitted shall be designed and built so as not to detract from the visual quality of the area. Design factors include size, shape, materials, color, location, and use.

POLICY #12 - The existing natural environment of the coastal zone as a whole is recognized as an important resource of the Quinault Indian Nation and shall be taken into account in all coastal zone management decisions and projects.

POLICY #13 - Forest harvest and management in the coastal zone shall be conducted so that there is the least degradation, both short-term and long-term, to the natural environment consistent with providing a reasonable economic return. Timber areas which are not economically harvestable without undo damage to the natural environment shall be preserved and managed as wildlife habitat.

POLICY #14 - Public access to and development of the coastal zone shall be discouraged until related political, legal, and jurisdictional issues are settled and defined to an extent that will allow full and proper management of the coastal zone.

POLICY #15 - The Quinault Indian Nation will continue to acquire ownership of land in the coastal zone to enhance its management capability as it is economically able to do so.

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